CHINA RAILWAY DESIGN CORPORATION
КОСТЕ РАЦИНА 16б, 11000 БЕОГРАД
САОБРАЋАЈНИ ИНСТИТУТ ЦИП д.о.о.
11000 БЕОГРАД, НЕМАЊИНА 6/IV
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2/4.1.1 НАСЛОВНА СТРАНА

2/4.1 ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА

Инвеститор:	„Инфраструктура Железнице Србије“ а.д. Немањина 6/4, Београд
Наручилац:	Конзорцијум фирми: China Railway International Corporation Ltd. China Communication Construction Company Ltd. (CCCC)
Објекат:	Пруга Београд - Суботица државна граница (Келебија), **ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА),** у Новом Саду, Кисачу, Степановићеву, Змајеву, Врбасу, Ловћенцу, Малом Иђошу, Бачкој Тополи, Жеднику, Наумовићеву и Суботици, К.О. Нови Сад I, К.О. Нови Сад IV, К.О. Кисач, К.О. Руменка, К.О. Степановићево, К.О. Ченеј, К.О. Бачко Добро Поље, К.О. Врбас, К.О. Врбас - град, К.О. Змајево, К.О. Куцура, К.О. Ловћенац, К.О. Мали Иђош, К.О. Фекетић, К.О. Бачка Топола, К.О. Бачка Топола - Град, К.О. Мали Београд, К.О. Биково, К.О. Доњи Град, К.О. Жедник, К.О. Нови Град, К.О. Палић, К.О. Стари Град, на катастарским парцелама према списку приложеном у Главној свесци
Врста техничке документације:	**ПГД-** Пројекат за грађевинску дозволу
Назив и ознака дела пројекта:	**ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА** **2/4.1 Зид од армиране земље у станици Нови Сад (km77+000 ~ km77+325)**
За грађење / извођење радова:	Нова градња
Пројектант:	China Railway Design Corporation Serbia Ogranak Beograd Косте Рацина 16б 11000 Београд, Србија
Одговорно лице пројектанта:	Генерални директор: 耿欣 (Генг Ксин)
Потпис:	XIN GENG Digitally signed by XIN GENG Date: 2021.08.03 10:00:57 +02'00'
Одговорни пројектант:	Зоран Луковић, дипл.грађ.инж. Лиценца број: 310 3032 03
Потпис:	ЗОРАН ЛУКОВИЋ 011041396 Sign Digitally signed by ЗОРАН ЛУКОВИЋ 011041396 Sign Date: 2021.08.01 16:01:24 +02'00'
Број дела пројекта:	2020-001-ГС-2/4.1
Место и датум:	Београд, април 2021.год.

CeS.TRA

ТЕХНИЧКА КОНТРОЛА ПРОЈЕКТА ЗА ГРАЂЕВИНСКУ ДОЗВОЛУ

2/4.1 ЗИД ОД АРМИРАНЕ ЗЕМЉЕ У СТАНИЦИ НОВИ САД (km77+000 ~ km77+325)

Објекта: Пруга Београд - Суботица - државна граница (Келебија), **ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)**, у Новом Саду, Кисачу, Степановићеву, Змајеву, Врбасу, Ловћенцу, Малом Иђошу, Бачкој Тополи, Жеднику, Наумовићеву и Суботици, К.О. Нови Сад I, К.О. Нови Сад IV, К.О. Кисач, К.О. Руменка, К.О. Степановићево, К.О. Ченеј, К.О. Бачко Добро Поље, К.О. Врбас, К.О. Врбас - град, К.О. Змајево, К.О. Куцура, К.О. Ловћенац, К.О. Мали Иђош, К.О. Фекетић, К.О. Бачка Топола, К.О. Бачка Топола - Град, К.О. Мали Београд, К.О. Биково, К.О. Доњи Град, К.О. Жедник, К.О. Нови Град, К.О. Палић, К.О. Стари Град, на катастарским парцелама према списку приложеном у Главној свесци, на основу Закона о планирању и изградњи („Службени гласник РС” бр. 72/09, 81/09 – исправка, 64/10 – одлука УС, 24/11, 121/12, 42/13 – одлука УС, 50/13 – одлука УС, 98/13 – одлука УС, 132/14, 145/14, 83/18, 31/19, 37/19 - др. Закон, 9/20 и 52/21) и одредби Правилника о садржини, начину и поступку израде и начину вршења контроле техничке документације према класи и намени објеката (“Службени гласник РС”, бр. 73/2019), извршена је техничка контрола предметне документације, од стране предузећа CESTRA d.o.o. Београд.

ПРОЈЕКАТ СЕ ПРИХВАТА

Вршилац техничке контроле: CESTRA d.o.o,
Макензијева 57, Београд

Број лиценце: 351-02-03374/2020-09 од 18.03.2021.

Одговорно лице/Заступник: Директор:
Драган Милић, дипл.грађ.инж.

Потпис:

Вршилац техничке контроле: Немања Шеловић дипл.грађ.инж.
Број лиценце: 310 P214 17

Потпис:

Број техничке документације: A10312-61/21

Место и датум: Београд, 2021.

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2/4.1.3 РЕШЕЊЕ О ОДРЕЂИВАЊУ ОДГОВОРНОГ ПРОЈЕКТАНТА

На основу члана 128а, Закона о планирању и изградњи ("Службени гласник РС", бр. 72/09, 81/09-исправка, 64/10- одлука УС, 24/11, 121/12, 42/13-одлука УС, 50/13-одлука УС, 98/13-одлука УС, 132/14, 145/14, 83/2018, 31/2019, 37/2019 - др.закон и 9/2020) и одредби Правилника о садржини, начину и поступку израде и начину вршења контроле техничке документације према класи и намени објеката ("Службени гласник РС", бр. 73/2019) као:

О Д Г О В О Р Н И П Р О Ј Е К Т А Н Т

за израду **ПРОЈЕКТА ПОТПОРНИХ КОНСТРУКЦИЈА - 2/4.1 Зид од армиране земље у станици Нови Сад (km 77+000 ~ km 77+325)**, који је део ПГД - Пројекта за грађевинску дозволу за изградњу пруге Београд - Суботица државна граница (Келебија), **ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)**, у Новом Саду, Кисачу, Степановићеву, Змајеву, Врбасу, Ловћенцу, Малом Иђошу, Бачкој Тополи, Жеднику, Наумовићеву и Суботици, К.О. Нови Сад I, К.О. Нови Сад IV, К.О. Кисач, К.О. Руменка, К.О. Степановићево, К.О. Ченеј, К.О. Бачко Добро Поље, К.О. Врбас, К.О. Врбас - град, К.О. Змајево, К.О. Куцура, К.О. Ловћенац, К.О. Мали Иђош, К.О. Фекетић, К.О. Бачка Топола, К.О. Бачка Топола - Град, К.О. Мали Београд, К.О. Биково, К.О. Доњи Град, К.О. Жедник, К.О. Нови Град, К.О. Палић, К.О. Стари Град, на катастарским парцелама према списку приложеном у Главној свесци, одређује се:

Зоран Луковић, дипл.грађ.инж _____310 3032 03

Пројектант:	CHINA RAILWAY DESIGN CORPORATION SERBIA OGRANAK BEOGRAD, Косте Рацина 16б
Одговорно лице/заступник:	Генерални директор: Генг Ксин, дипл.инж.
	Потпис:
Број техничке документације:	2020-001-ГС-2/4.1
Место и датум:	Београд, април 2021.год.

2/4.1.4 ИЗЈАВА ОДГОВОРНОГ ПРОЈЕКТАНТА

Одговорни пројектант **ПРОЈЕКТА ПОТПОРНИХ КОНСТРУКЦИЈА - 2/4.1 Зид од армиране земље у станици Нови Сад (km 77+000 ~ km 77+325)** који је део ПГД -Пројекта за грађевинску дозволу за изградњу пруге Београд - Суботица државна граница (Келебија), **ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)**, у Новом Саду, Кисачу, Степановићеву, Змајеву, Врбасу, Ловћенцу, Малом Иђошу, Бачкој Тополи, Жеднику, Наумовићеву и Суботици, К.О. Нови Сад I, К.О. Нови Сад IV, К.О. Кисач, К.О. Руменка, К.О. Степановићево, К.О. Ченеј, К.О. Бачко Добро Поље, К.О. Врбас, К.О. Врбас - град, К.О. Змајево, К.О. Куцура, К.О. Ловћенац, К.О. Мали Иђош, К.О. Фекетић, К.О. Бачка Топола, К.О. Бачка Топола - Град, К.О. Мали Београд, К.О. Биково, К.О. Доњи Град, К.О. Жедник, К.О. Нови Град, К.О. Палић, К.О. Стари Град, на катастарским парцелама према списку приложеном у Главној свесци:

Зоран Луковић, дипл. грађ.инж.

И З Ј А В Љ У Ј Е М

1. да је пројекат у свему у складу са издатим Локацијским условима:
-бр.ROP-MSGI-28188-LOCH-4/2020, Заводни број: 350-02-00031/2020-14 од 06.04.2020,
-бр.ROP-MSGI-28188-LOCH-4/2020, Заводни број: 350-02-00031/2020-14 од 07.04.2020 - Решење о исправци грешке,
-бр.ROP-MSGI-7141-LOC-1/2020, Заводни број: 350-02-00109/2020-14 од 08.05.2020,
-бр.ROP-MSGI-931-LOC-3/2020, Заводни број: 350-02-00192/2020-14 од 29.05.2020;
2. да је пројекат израђен у складу са Законом о планирању и изградњи, прописима, стандардима и нормативима из области изградње објеката и правилима струке;
3. да је пројекат у свему у складу са начинима за обезбеђење испуњења основних захтева за објекат прописаних елаборатима и студијама.

Одговорни пројектант:	Зоран Луковић, дипл.грађ.инж.
Број лиценце:	310 3032 03
	Потпис:
Број техничке документације:	2020-001-ГС-2/4.1
Место и датум:	Београд, април 2021.год.

2/4.1.5 ТЕКСТУАЛНА ДОКУМЕНТАЦИЈА

2/4.1.5.1 ТЕХНИЧКИ ОПИС

ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА - 2/4.1 Зид од армиране земље у станици Нови Сад (km 77+000 ~ km 77+325)

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  4.4 Темељи
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6 Анализа сеизмике
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8 Гранично стање употребљивости
9 Изградња зида од армиране земље

1 УВОД

Пројектом нове пруге Нови Сад - Келебија планирана је изградња новог перона који се налази на спољној страни 6. колосека станице Нови Сад. Да би се смањила заузетост бочног дела перона и смањила употреба земљишта, на десној страни нагиба насипа пројектује се потпорни зид уместо косине.

Према Идејном пројекту, који је одобрила Републичка Ревизиона Комисија (РРК), постављен је потпорни зид од армиране земље на десној страни перона на стацинажи km77+000~km77+325 (или 6. колосек), укупне дужине конструкције око 325m.

У поређењу са традиционалним армирано-бетонским зидом, зид од армиране земље је флексибилна потпорна конструкција која има предности у погледу деформација и отпорности на земљотрес и његовим коришћењем постижу се уштеде у погледу армираног бетона, заузимања земљишта и времена извођења радова.

У фази Пројекта за грађевинску дозволу задржава се решење за зид од армиране земље за овај део, а за формирање чела зида користе се бетонски блокови.

2 Стандарди

У Србији је не постоји техничка спецификација за пројектовање зидова од армиране земље.

EN 14475 Предговор: Пројекат конструкција од армиране земље тренутно се изводи користећи националне стандарде као што су BS 8006 (1995), NF P 94-220 (1998) и други стандарди. У ствари, EN 1997-1, Eurocode 7 (Геотехнички пројекат) тренутно не покрива детаљни пројекат конструкција од армиране земље. Вредности делимичних фактора и фактора оптерећења дате у EN 1997-1 нису калибрисане за конструкције од армиране земље.

Стога се за овај пројекат углавном користи британски стандард BS 8006-1:2016: Стандард за ојачанау/ армирану земљу.

За тестирање геомреже, користи се спецификације геосинтетике EN и ISO.

Спецификације које су коришћене у техничким извештајима су следеће:

—Европске норме за конструкције:

EN 1992-1-1, Eurocode 2: Пројектовање бетонских конструкција - Део 1-1: Општа правила и правила за зграде.

EN 1997, Eurocode 7: Пројектовање Геотехничких конструкција.

EN 1998, Eurocode 8: Пројектовање конструкција отпорних на земљотрес.

EN 14475:2006, Извођење посебних геотехничких радова -армирана земља.

—Британски стандарди за зидове од армиране земље

BS 8006-1:2010+A1:2016: Стандард за ојачање/армирану земљу и друге испуне.

—Амерички стандарди за зидове од армиране земље

AASHTO LRFD Спецификације пројекта моста (део зидови од армиране земље) 2017/8.

FHWA-NHI-10-024 Пројектовање и извођење механички стабилизованих зидова од земље и ојачаних косина тла - Том 1.

—Немачки стандарди за пројектовање зидова од армиране земље

Предлози за ојачање геосинтетике EBGEO.

— Кинески стандард за зидове од армиране земље

TB 10025:2019, Стандард за пројектовање потпорних конструкција за доњи строј пруге.

— Спецификација за експерименте са геомрежом

EN ISO 10319:2015, Геосинтетика – Затезно испитивање.

EN 13250:2014+A1:2015, Геотекстили и производи повезани са геотекстилом - Карактеристике потребне за употребу у изградњи железница.

EN 13251:2014+A1:2015, Геотекстили и производи повезани са геотекстилом -

Карактеристике потребне за употребу у земљаним радовима, темељима и потпорним конструкцијама.

EN ISO 13431:1999, Геомреже и производи повезани са мрежом - Одређивање затезног пузања и пуцања пузања.

ISO/TR 20432:2007, Смернице за одређивање дуготрајне чврстоће геосинтетике за ојачање тла.

3 Геотехничка својства тла

Подаци о геотехничким карактеристикама темељног тла добијени су из геоелабората "CRDC-Retaining wall km77+000 - km77+325".

За карактеристичне вредности природног темељног тла које су одређене овим геоелаборатом видети табелу 3-1.

За минималне геолошке вредности испуне зида од армиране земље и земље која остаје на насипу, а које је искуствено одредио пројектант, видети табелу 3-2.

Током процеса изградње, треба проверити геотехничке карактеристике тла у сваком хомогеном делу, а узорке однети у лабораторију на испитивање. Ако су геотехничка својства нижа од вредности у табели 3-2, треба предузети одговарајуће мере како би се осигурала стабилност радова.

У геоелаборату се види да је ниво подземне воде нижи од висине темеља зида од армиране земље, а пројекат није узео у обзир утицај воде на геотехничке карактеристике. Постављање дренажног слоја иза зида од армиране земље може да осигура да неће настати притисак воде у испуни од армиране земље. У прорачуну стабилности за ову локацију није узет у обзир утицај притиска воде.

Табела 3-1 Геотехничке карактеристике природног темељног тла

Бр.	**Назив**	Дебљина слоја	Специфична тежина γ	Ефективна кохезија c'	Ефективни угао трења φ'	Модул сабијања Es
		m	kN/m^3	kPa	°	kpa
1	nt	1.5	18.0	0	27	4200
2	Sa1	6.0	18.5	1	31	6718
3	Sa2	7.5	20.0	0	34	10672
Усвојена пројектна вредност (хомогено темељно тло)			**18.5**	**0**	**31**	

Табела 3-2 Механичка својства тла испуне зида од армиране земље

Део испуне	Специфична тежина (γ)	Ефективна кохезија (c')	Ефективни угао трења (φ')
	kN/m^3	kPa	(°)
Испуна армиране земље	19.5	0	33
Испуна од задржане земље	19.5	0	30

4 Избор типа зида од армиране земље

4.1 Сегментни блок зидови

Постоји много врста потпорних зидова од армиране земље, сваки са својим карактеристикама. Избор типа зида за овај пројекат углавном се базира на следећем:

— Потпорни зидови од армиране земље граде се на темељном тлу.

— Сви елементи конструкције за изградњу треба да буду лаки ради транспорта и уградње.

— Зидови не захтевају одржавање током експлоатације.

С тога је за зид од армиране земље узет систем сегментних блок зидова са једноаксијалном затезном геомрежом. Такав систем укључује зидове од префабрикованих бетонских блокова, конекторе за зидне блокове, аксијалне растегнуте полиетиленске (HDPE) геомреже високе густине, HDPE решетке за повезивање геомрежа и материјал за сабијање испуне.

4.2 Бетонски блокови

Чеону површину потпорних зидова од армиране земље чине бетонски блокови. Детаљи се могу наћи у цртежима пројекта.

На дну бетонских блокова треба да буде испупчена површина, а на врху површина са жлебом, тако да се једноаксијална затегнута геомрежа може причврстити специјалним пластичним конекторима како би се обезбедило da пројектована чврстоћа геомреже на површини зида не буде смањена.

Стога овај систем може узети у обзир укупну пројектовану чврстоћу геомреже у статичким и сеизмичким условима.

4.3 Геомрежа

Геомрежа у зидовима од армиране земље треба да буде повезана са сегментираним бетонским блоковима.

Како би се обезбедило да чврстоћа везе достигне пројектовану чврстоћу арматуре, геомрежа треба да се затегне у једном правцу. Овај тип геомреже је интегрални производ који се добија ударањем и растезањем HDPE панела, а може се повезати са зидом од блокова помоћу пластичних конектора како би се обезбедила потребна чврстоћа везе.

4.4 Темељи

Потпорни зид од армиране земље је флексибилна конструкција која се може прилагодити различитим слегањима без угрожавања своје стабилности. Систем зида одабран за овај пројекат је систем сегментираног бетонског блока који је заправо полукрута конструкција.

Како би се избегло хоризонтално померање бетонских блокова и напрслине у систему завршне обраде, пројектован је бетонски темељ "L" профила, који карактеришу предњи зуби који

спречавају директно клизање постоља зида ка спољa. Погледати пројектни цртеж темељ.

5 Метода пројектовања зидова од армиране земље

Пројекат је у потпуности усклађен са стандардима EN1997-1 и EN1998, а заснован је на методи граничног стања, и то: граничном стању носивости и граничном стању употребљивости.

Процес пројектовања зидова од армиране земље је следећи:

• Најпре се мора решити унутрашња стабилност, да би се одредио размак између геомреже, дужина геомреже и веза са радном површином. Овим се успоставља укупни интегритет зида од армиране земље.

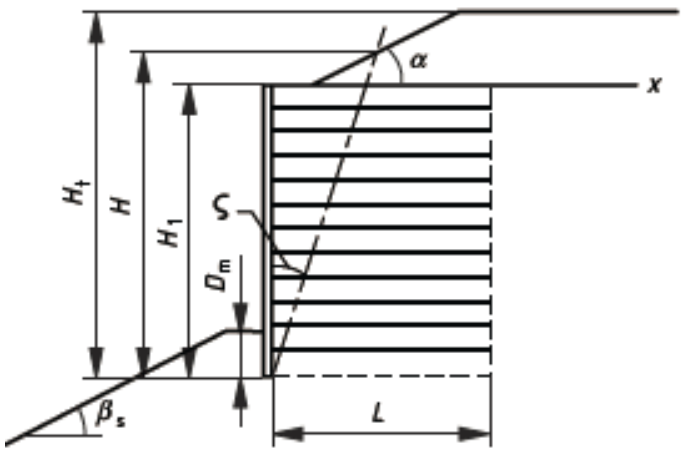
• Спроводи се испитивање спољне стабилности против превртања, клизања и оштећења темеља, и у складу с тим проверава или модификује унутрашњи пројекат. Овим се потврђује да ће зид од армиране земље остати стационаран.

• Спроводи се анализа укупне стабилности да би се осигурало да не постоји механизам оштећења који укључује армирану земљу, испуну иза армиране испуне и темељно тло. Овим се потврђује да ће зид од армиране земље и околно земљиште остати непомерљиви.

• Остала разматрања укључују завршне детаље зида и спољну дренажу. Овим се решавају остали могући проблеми у вези са стабилношћу.

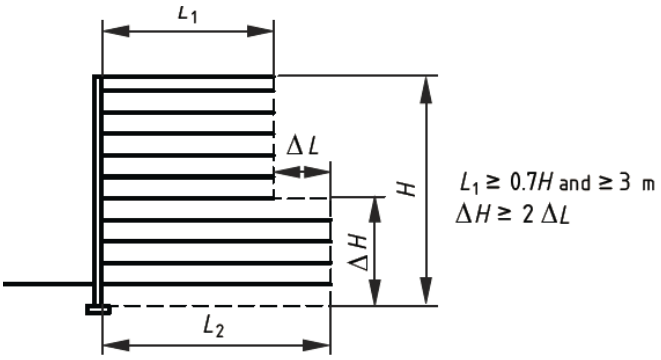
5.1 Величина конструкције

У комбинацији са задатом висином зида од армиране земље и карактеристикама темељног тла локације, укупна геометрија конструкције и захтеви за минималну почетну величину приказани су на слици 5.1.



H = Mechanical height
H_1 = Facing height
H_t = Total height
ς = Arc tan 0.3
L = Reinforcement length
D_m = Embedment depth
$L \geq 0.7H$ and ≥ 3 m

а) Правоугани пресек



б) Степенасти пресек

Сл. 5.1 Геометрија и димензије зида

Према прописима о дубини смрзавања у Србији, дубина уградње зида од армиране земље Dm не треба да буде мања од 0,8m.

5.2 Парцијални коефицијент

Тренутно у различитим земљама не постоје парцијални коефицијенти за зидове од армиране земље. Позивајући се на саобраћајно оптерећење аутопута из стандарда BS 8006, парцијални коефицијенти за овај пројекат су приказани у табели 5.2.

Табела 5.2 Парцијални коефицијенти коришћени у овом пројекту

Парцијални коефицијенти			Гранично стање носивости		Гранично стање употребљивости
			A	B	C
Коефицијенти оптерећења	Густина земље за испуну зида	Квалитет армиране земље: f_{fs}	1,5	1,0	1,0
		Квалитет земље за испуну на врху армиране земље: f_{fs}	1,5	1,0	1,0
	Притисак земље иза армиране земље: f_{fs}		1,5	**1,5**	1,0
	Спољно сопствено оптерећење	Оптерећење колосека: f_f	1,5	1,0	1,0
	Спољно покретно оптерећење	Оптерећење воза: f_q	1,5	1,0	0
Коефицијенти материјала тла: fms	tan (φ' p)		1,0		1,0
	c ’		**1,6**		1,0
	c_u		1,0		1,0
Коефицијенти материјала арматуре: fm	Примењује се на основну чврстоћу арматуре **Тв**		Вредност fm треба да буде конзистентна са врстом арматуре која ће се користити и пројектним веком коришћења		

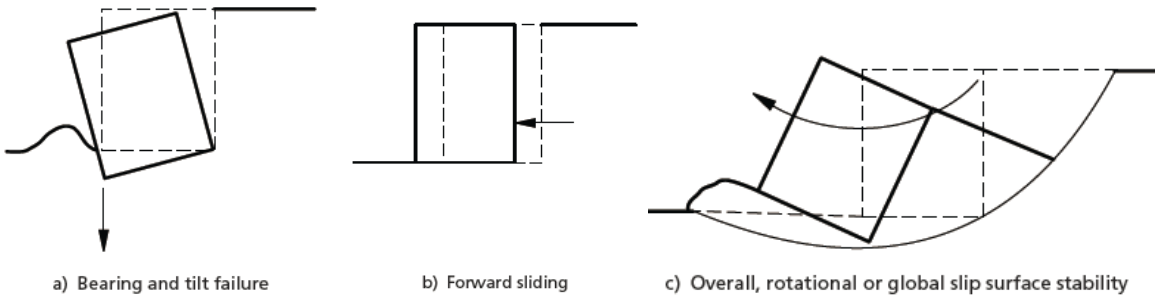
Парцијални коефицијенти		Гранично стање носивости		Гранично стање употребљивости
		A	B	C
Коефицијенти интеракције земљишта и арматуре	Коефицијент клизања дуж површине арматуре: fs	fs=1,3		fs=1,0
	Коефицијент отпора на извлачење арматуре: fq	fp=1,3		fp=1,0
Парцијални коефицијенти сигурности	Носивост темеља fms: примењује се q_{ult}	fms=1,35		NA
	Клизање дуж темеља конструкције или било које хоризонталне површине где постоји додир земље са земљом fs	fs=1,2		NA

5.3 Анализа спољне и унутрашње стабилности

5.3.1 Анализа спољне стабилности

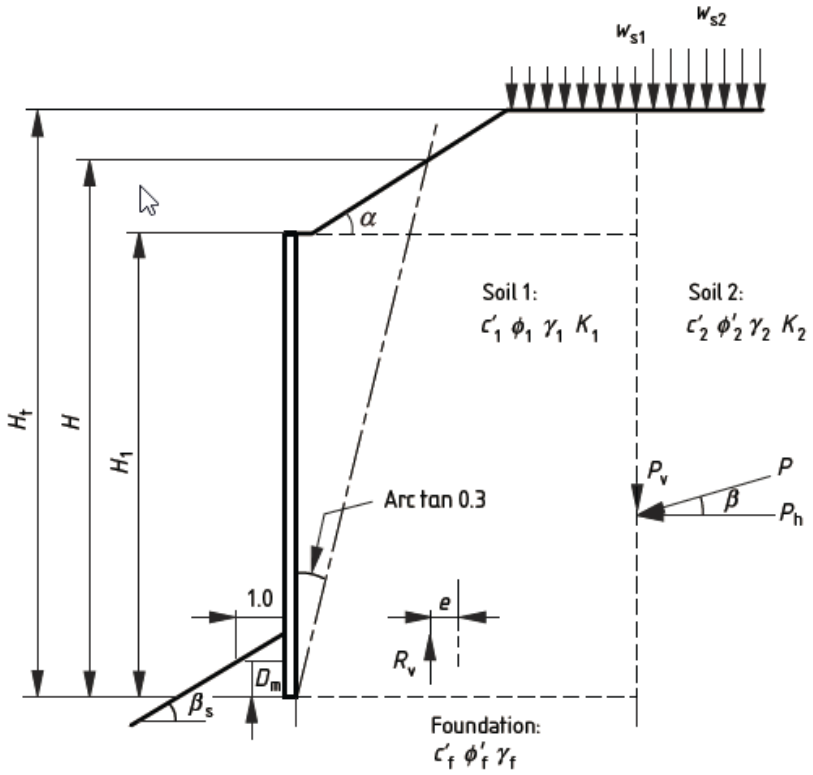
Потпорни зид од армиране земље у суштини и даље спада у категорију гравитационих потпорних зидова, а постојећи стандарди за пројектовање потпорних зидова од армиране земље претпостављају да је армирана земља круто тело. Метода анализе његове спољне стабилности у суштини је иста као и за традиционалне потпорне зидове и укључује носивост, превртање, клизање и лом по луку, као што је приказано на слици 5.3.1-1.

Анализа носивости и превртања, типични притисак који врши конструкција од армиране земље на темељ и пројектовани претпостављени притисак потпоре заснивају се на Meyerhof расподели.



Сл. 5.3.1-1 Анализа спољне стабилности (с лева на десно): Носивост и превртање; клизање директно на постољу; ротација или клизање у целости

Дефиниција карактеристика тла армиране земље, испуне и темеља, као и главног оптерећења и додатног оптерећења која се узимају у обзир при прорачуну стабилности, приказани су на слици 5.3.1-2.



NOTE $\beta = 0$ *for tie back wedge method,* $\beta = (1.2 - L/H)\phi'_2$ *for coherent gravity method.*

Сл. 5.3.1-2 Дефиниција карактеристика тла и оптерећења

5.3.2 Анализа унутрашње стабилности

Механизам оштећења унутрашње стабилности потпорног зида од армиране земље обухвата два мода: затезно прекидање арматуре и извлачење арматуре. Током вршења анализе унутрашње стабилности, цела конструкција армиране земље је подељена на два дела на основу претпостављене локације површине прелома арматуре: активну и пасивну зону. Функција арматуре је да апсорбује напрезање које ствара земља у активној зони када су чврстоћа арматуре и сила сидрења између арматуре и земље довољни, а онда га затезном силом арматуре преноси у пасивну зону и затим постепено шири од арматуре на земљу у пасивној зони.

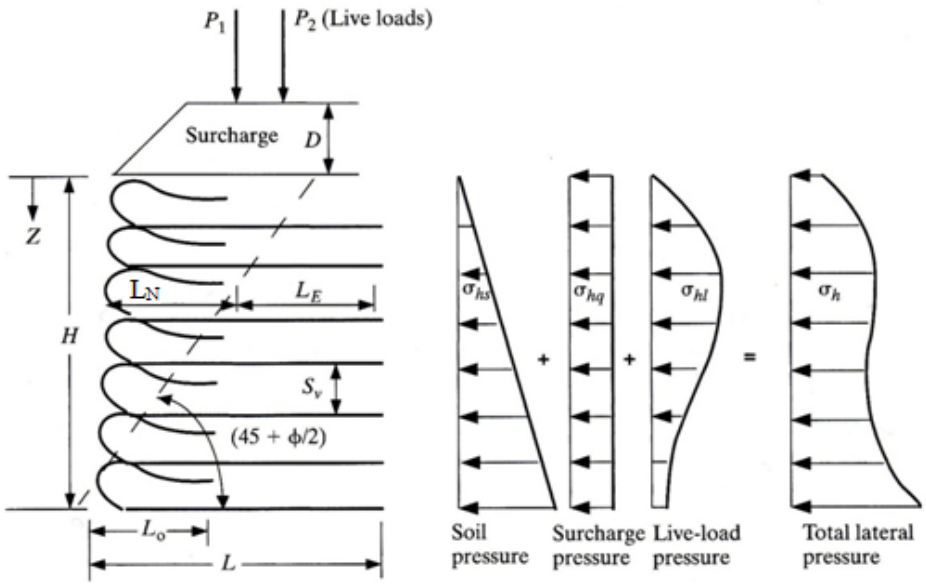
Срж пројекта унутрашње стабилности потпорног зида од армиране земље је прорачун силе арматуре. Прорачун затезне силе арматуре директно утиче на пројектовану чврстоћу, размак и унутрашњу стабилност арматуре.

Максимална затезна сила Tj сваког слоја арматуре је кључ унутрашње стабилности и економичног пројекта потпорног зида од армиране земље.

Према одредбама стандарда BS 8006, за унутрашњу стабилност потпорног зида армираног геомрежом претпоставља се tie-back модел, где је површина лома равна линија која почиње од прста и нагнута је (45°+φ/ 2), као што је приказано на слици 5.3.2-1.

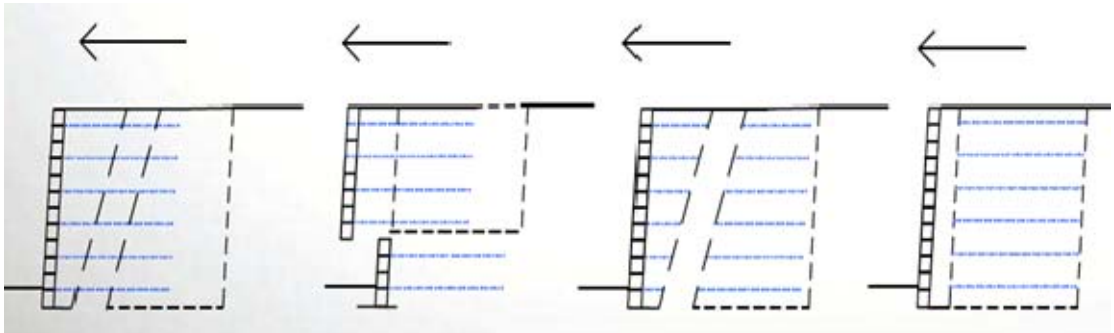
Да би се утврдио вертикални размак између слојева геомреже, претпоставља се да су силе сабијања земље за насипање и вишка земље линеарно распоређене и задовољавају услов Rankine-овог активног притиска земље. Boussinesq теорија еластичности користи се за израчунавање покретног оптерећења земље за насипање.

Укупна дужина геомреже L биће дужина зоне сидрења L_E иза површине прелома, плус неактивна дужина геомреже у активној зони испред површине прелома L_N, односно $L=L_E+L_N$.



Сл. 5.3.2-1 Шема анализе унутрашње стабилности зида од армиране земље

Анализа унутрашње стабилности је решила следеће механизме оштећења (Сл. 5.3.2-2): извлачење геомреже; директно клизање низ геомрежу; затезно прекидање геомреже; веза геомреже и блока зида.



Сл. 5.3.2-2 Механизам унутрашњег оштећења (с лева на десно): извлачење геомреже; директно клизање; затезно прекидање геомреже; оштећење везе геомреже и блока зида

5.4 Анализа укупне стабилности

Након завршетка пројекта унутрашње и спољне стабилности, потребно је спровести анализу укупне стабилности како би се осигурало да не постоји механизам оштећења за армирану земљу,

тло иза армиране земље и темељно тло.

Анализу укупне стабилности треба извршити на следећи начин:

— Клизање дуж кружних површина (ротациона стабилност)

Под претпоставком да постоји кружна површина лома, тло окружено овом површином подељено је на мноштво клизишта подељених вертикалним површинама, а за свако клизиште се могу израчунати активни моменти изазвани потиском тла, моменти отпора и/или кохезије изазвани трењем и затезна чврстоћа слоја геомреже (види слику 5.4-1); коефицијент сигурности је однос збира момената отпора и збира активних момената; проучавано је много кружних површина и за сваку од њих формула за израчунавање коефицијента сигурности (FS) је следећа:

$$FS = FS_{unreinforced} + M_r / M_a$$

$FS_{unreinforced}$ = коефицијент сигурности за одабрану кружну површину, не узимајући у обзир постојање арматуре од геомреже;

M_r = момент отпора који пружа арматура од геомреже = Σ Ti·bi;

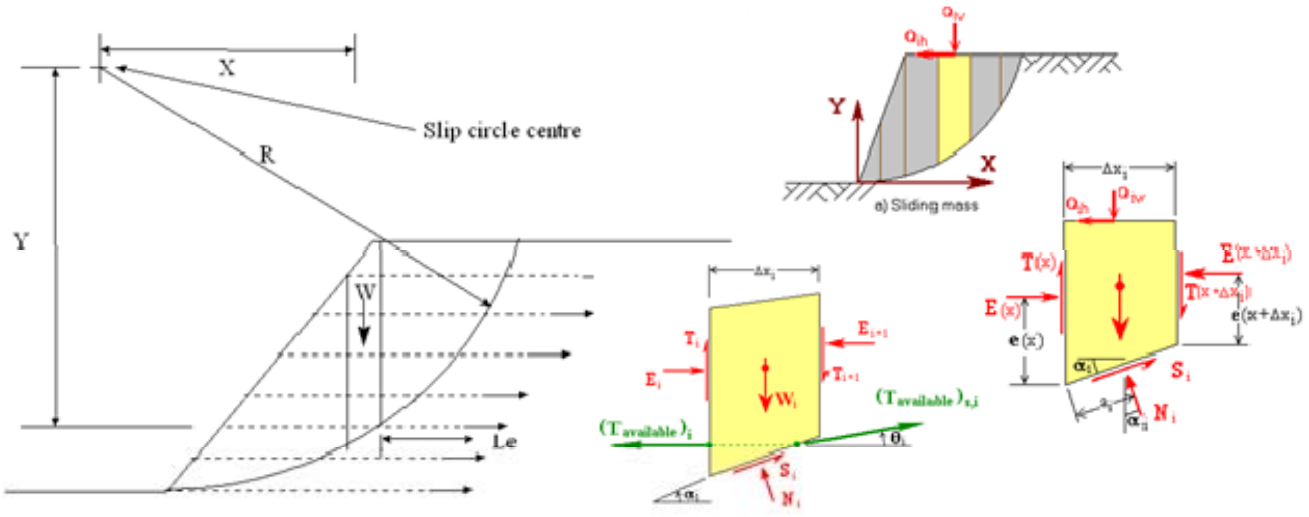
Ti = затезна чврстоћа на пресеку i-тог дела арматуре и одабране кружне површине;

bi = крак силе геомреже која почиње од центра одабраног круга;

M_a = активни момент.

За анализу ротационе стабилности обично се користи Bishop метода (1955), пошто се овом методом могу узети у обзир све силе које делују на клизишта (Слика 5.4-1).

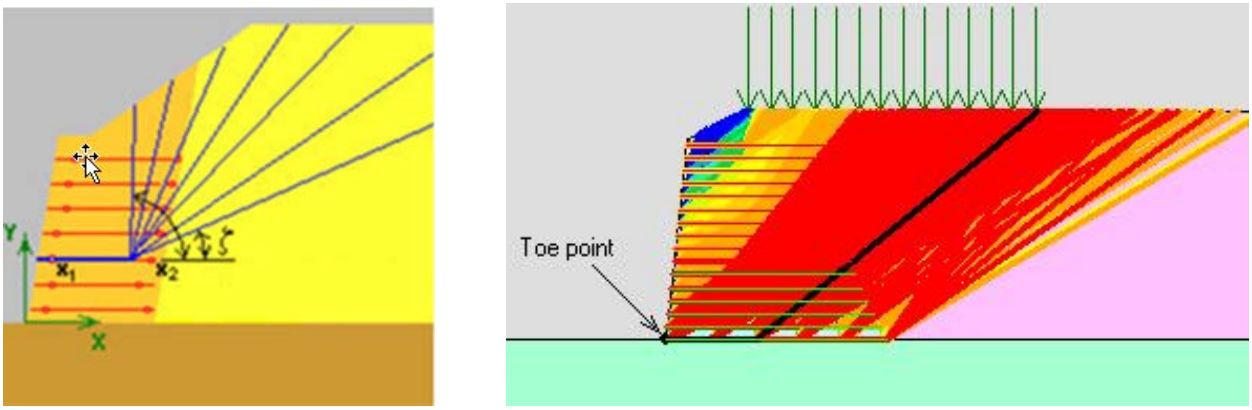
$$FS = \frac{\Sigma\{c_i \times b_i + (W_i - u_i \times b_i + \Delta X_i) \times \tan\varphi_i\} \times \frac{\sec\alpha_i}{1 + \tan\alpha_i \times \tan\varphi_i / F}}{\Sigma W_i \times \sin\alpha_i}$$



Сл. 5.4-1 Шема анализе за ротациону стабилност

— Транслаторно клизање (хоризонтална стабилност)

Маса армиране земље, и можда део масе земље иза њега, могу да клизају као крути блок дуж темеља или дуж једног од слојева геомреже. Стога су проучене бројне билинеарне површине. Хоризонтални сегмент одговара растућем делу сваког слоја геомреже, а нагнути сегмент сваког хоризонталног сегмента има другачији угао за (Слика 5.4-2); израчунавају се силе отпора и активне силе за сваку билинеарну површину, чији однос даје коефицијент сигурности. Ово се назива Spencer методом.



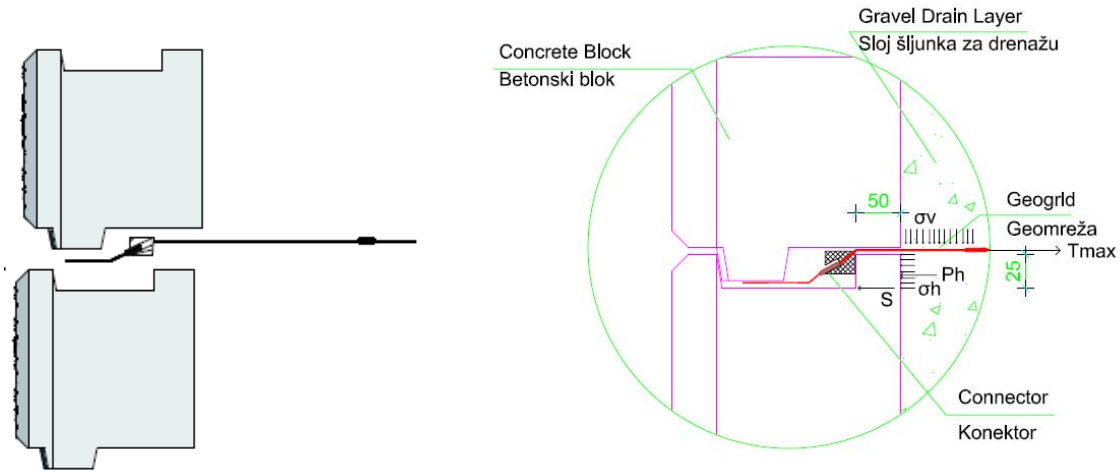
Сл. 5.4-2 Шема анализе за транслаторну стабилност

5.5 Анализа чврстоће на смицање бетонског блока

На споју између геомреже и бетонског блока, затезна сила у геомрежи се опире отпором вертикалног дела бетонског блока, а пластични конектор наслања се на тај вертикално део бетонског блока.

На другој страни вертикалног дела блока, испуна врши хоризонтални притисак услед потиска тла.

Као што је приказано на Слика 5-5, дно бетонског блока је тада подвргнуто сили смицања, што може довести до лома самог бетонског блока ако се премаши чврстоћа на смицање бетона.



Сл. 5-5 Поједностављена шема компонената сила конектора

На основу техничких захтева стандарда EN 1992-1 за компоненте мршавог бетона отпорне на смицање под притиском, анализира се чврстоћа на смицање бетонских блокова.

За пресек где сила смицања VEd и нормална сила NEd делују на притиснуту зону Acc, апсолутну вредност компоненте пројектованог напрезања треба узети као:

$$\sigma_{cp}=N_{Ed}/Acc$$

$$\tau_{cp}=k\ V_{Ed}/Acc$$

Препоручена вредност k=1,5 и треба проверити следеће: $\boldsymbol{\tau_{cp} \leq f_{cvd}}$

where:

if $\sigma_{cp} \leq \sigma_{c,lim}$ $\quad f_{cvd} = \sqrt{f_{ctd}^2 + \sigma_{cp} f_{ctd}}$

or

if $\sigma_{cp} > \sigma_{c,lim}$ $\quad f_{cvd} = \sqrt{f_{ctd}^2 + \sigma_{cp} f_{ctd} - \left(\frac{\sigma_{cp} - \sigma_{c,lim}}{2}\right)^2}$

$$\sigma_{c,lim} = f_{cd} - 2\sqrt{f_{ctd}\left(f_{ctd} + f_{cd}\right)}$$

where:

f_{cvd} is the concrete design strength in shear and compression
f_{cd} is the concrete design strength in compression
f_{ctd} is concrete design strength in tension

Чврстоћа бетона пројектованог блока је C30/37, а максимално затезно оптерећење арматуре је Tmax=30kN/m. Резултат прорачуна заснован је на најнеповољнијој комбинацији:

τ_{cp}=0.86MPa < f_{cvd}=1.60MPa. Задовољава пројектне захтеве.

6 Сеизмичка анализа

Конструкције од армиране земље имају широку употребу у сеизмички активним областима и добро су се показале при многим јаким земљотресима.

Пројекат конструкција потпорних зидова под сеизмичким оптерећењем изводи се у складу са стандардом EN 1998-5. Међутим, Еурокод се не бави посебно сеизмичким пројектом конструкција од армиране земље.

Извлачећи поуке из европског сеизмичког стандарда за потпорне конструкције и релевантних стандарда за сеизмички пројекат конструкција од армиране земље, за пројектовање модела се користи статичка метода. Наиме, сеизмичка сила која делује на конструкцију је гравитација конструкције помножена са хоризонталним сеизмичким коефицијентом kh.

Према националној мапи дистрибуције сеизмичких зона Србије, сеизмички параметри који се користе у сеизмичком пројекту за зидове од армиране земље су следећи:

Референтно вршно убрзање тла на тлу типа A, a_{gR}=0.1g;

Темељ зида од армиране земље налази се на кохезивном тлу, а категорија слоја се сматра E класом, према коефицијенту тла S=1,4 дефинисаном у члану 3.2.2.2 стандарда EN1998-1;

$a=a_g/g=\gamma_I \times a_{gR}/g=1.0\times 0.1g/g=0.1$

$kh=a\times S/r=0.1\times 1.4/2.0=0.07$

$kv=\pm 0.5kh=\pm 0.035$.

7 Пројекат зида од армиране земље

Према стандарду BS 8006, пројектни век зидова од армиране земље је 120 година.

Конструкција од армиране земље анализирана је и пројектована у статичким и сеизмичким условима. Утврђено је неколико типичних попречних пресека, а за сваки попречни пресек извршена је анализа унутрашње, спољне и укупне стабилности.

Анализе унутрашње и спољне стабилности извршене су помоћу MSEW софтвера који је произвела

компанија Adama Engineering (Massachusetts, USA), а одобрила га је Федерална управа за аутопутеве (FHWA) у САД.

Да би софтвер био компатибилан са спецификацијама BS 8006, EN 1997 и EN 1998, параметри оптерећења и тла су разложени, а сеизмички параметри постављени према сеизмичким коефицијентима kh и kv израчунатим у 6. одељку (за детаље, видети прорачун 2/4- 2.6.2).

Анализе целокупне стабилности у статичким и сеизмичким условима изведене су RESSA софтвером, произведеним у компанији Adama Engineering (Massachusetts, USA) и одобреном од стране Федералне управе за аутопутеве (FHWA) у САД.

Минимални коефицијент сигурности је 1,30 у статичким условима и 1,10 у сеизмичким условима.

Урађени су прорачуни за 5 типична пресека са различитим висинама зида. Све врсте резултата прорачуна израчунати су према максималном граничном стању носивости (комбинација A и комбинација B), односно граничном стању употребљивости (комбинација C), да би се упоређивањем утврдио најнеповољнији резултат сваке комбинације.

Генерално, комбинација B контролише прорачун против клизања и из њега се одређује дужину арматуре; пројектна чврстоћа арматуре обично је одређена граничним стањем употребљивости.

Прорачунски лист 2/4-2.6.2 наводи резултате унутрашње, спољне и укупне анализе стабилности максималне висине зида у статичким и сеизмичким условима.

Коначни распоред геомреже погодан за сваку висину зида пројектован је према резултатима прорачуна. Геомрежа изабрана за ову локацију је:

— RW-95 једноаксијална затезна геомрежа, карактеристичне затезне чврстоће Tchar=95kN/m;

Екстраполирана јачина течења на крају пројектног века: T_{CR} мора да испуњава услове пројектног века од 120 година и пројектне температуре од 20°C, вредност T_{CR} предвиђена је BBA сертификатом; T_{CR} типа RW-95 ≥42,5 kN/m.

Овакав распоред задовољава минималну чврстоћу и дужину геомреже потребне за унутрашњу, спољну и глобалну анализу стабилности.

8 Гранично стање употребљивости

За пројектовану конструкцију од армиране земље, следеће деформације треба узети у обзир у

граничном стању употребљивости:

а) слегање подтла;

б) унутрашње сабијање испуне;

ц) унутрашње напрезање услед течења арматуре;

д) напрезање услед течења испуне са високим ситнозрним садржајем.

Овај пројекат користи следеће мере како би се достигли захтеви граничног стања употребљивости за зидове од армиране земље.

а) Ископавање 0,5m испод темеља конструкције од армиране земље и замена крупнозрном земљом како би зид од армиране земље лежао на стабилном земљишту; користити крупнозрни материјал као испуну за арматуру, са високим степеном збијености Dpr≥95%. На овакав начин решавају се проблеми а), б) и д).

б) Унутрашње напрезање услед течења арматуре

Претпостављено затезно оптерећење према напрезању услед течења на крају пројектног века: T_{CS}, TCS вредност дата је BBA сертификатом. Према пропису BS 8006, максимално дозвољено унутрашње напрезање зидова од армиране земље након изградње са пројектним веком трајања од 120 година је 1%. Пројектна затезна чврстоћа T_{CS} арматуре одређује се према овим условима напрезања и пројектованом температуром од 20°C. Захтеви за пројектовање ове секције су следећи:

RW-95 тип T_{CS}≥18,0 kN/m**.**

9 Изградња зидова од армиране земље

За изградњу конструкције од армиране земље сегментним бетонским блоковима, треба се придржавати следећих грађевинских процедура према детаљним грађевинским цртежима:

Основа темеља (обрада подтла)

—На целој површини зида комплетно ископати и уклонити површинско тло. Према–цртежима, дебљина ископа и замене испод пројектне коте темеља не би требало да буде мања од 0,5m. а према геоелаборату првобитна носивост темеља након ископа треба да достигне $\mathbf{E_{vd}}$**≥20MPa**, ископати и поравнати по дужини геомрежа (L+0,5m), како би се обезбедило хоризонтално истезање геомреже унутар целе пројектне дужине.

—Замена подтла треба да се уради у слојевима. Проверити носивост темеља пре полагања геомрежа тако да задовољава $\mathbf{E_{vd} \geq 30MPa}$.

— Основу темеља треба урадити према коти приказаној на цртежу.

—Уколико се испод темеља налази муљевито тло, оно се мора се комплетно ископати и заменити. Ако носивост темеља након ископа и носивост темеља након замене не удовољавају горе наведеним пројектним захтевима, предузеће се даље мере ојачавања према захтевима надзорног инжењера.

Носивост темеља мора да провери и одобри надзорни инжењер пре следећег корака. Испод темеља облика L изливен је бетонски тампонски слој од бетона C12/15, дебљине 0,1m, како би се осигурало да висина темеља буде иста у паралелном правцу и смеру попречног пресека.

Темељи

— Бетонски темељ "L" облика мора бити изведен у складу са пројектним димензијама како би издржао напрезање које узрокује предња страна зида и обезбедио довољну носивост.

—Површина темеља мора бити потпуно глатка и нивелисана. Доњу површину првог слоја блокова која је равна поставити равно на темељ. Површина зида од блока мора бити поравната са вертикалном површином унутар предњих зуба "L" темеља.

Испуна

Испуна за арматуру састоји се од мешавине 0/63 шљунка и песка. Испуна треба да буде добре градације (C_U>6) и постављена испод и изнад геомреже. Дебљина слоја за сабијање треба да буде 22cm како би се осигурало најбоље пријањање између насипа и геомреже. E_{v2} треба да буде једнак 45MN/m^2 у прва 2 метра висине насипа, а степен сабијања између трећег метра насипа и врха насипа треба најмање да задовољава E_{v2}=60MN/m^2.

Део насипа на удаљености од 1,5 метра од зида треба сабијати лакшим ваљком и вибро плочама, а избегавати употребу тешких вибратора како би се избегла деформација чела зида.

Понављати поступак док се не постигне жељена висина горњег дела зида.

Геомрежа

— Гео-мреже достављају се на градилиште у ролнама, минимална ширина геомреже не треба да буде мања од 1,00m.

— Сила која делује на геомрежу у подужном правцу мора бити управна у односу на зид. Геомрежа постављена дуж правца потпорног зида морају бити међусобно повезане.

Дренажа

Дренажни слој поставља се иза зида бетонског блока. За материјал се узима шљунак, пречника 16/32 и дебљине 0,5m. Између дренажног слоја и испуне насипа поставља се неткани слој геотекстилног филтера (300g/m^2). Тло испред зида мора да има нагиб за одвод не мањи од 5% ка споља, или дренажни систем на траси. Погледајте "Детаљан цртеж" за техничке захтеве постављања.

Круна зида и ограда

Круна зида је израђена од бетона класе C30/37, V-I и *XF3*. Технички захтеви за круну зида и ограде детаљно су наведени у цртежима.

Изградња бетонских блокова

Изградња свих конструкција од армиране земље изводи се у слојевима и фазама. Израда зида од армиране земље треба изводити наизменично затрпавањем тла, равнањем, нивелисањем и сабијањем. Ако нивелета темеља конструкције од армиране земље није једнака, радове обично треба започети од најнижег дела темеља.

Радове треба изводити у складу са захтевима EN 14475. У наставку је дат поступак изградње:

Корак 1. Поставите први слој блокова, обраћајући посебну пажњу на уздужно поравнање блокова тако да горња страна буде потпуно равна.

Корак 2. На задњој страни зида поставља се дренажни слој шљунка дебљине 50cm. Неткани геотекстил од 300g/m2 поставља се између слоја шљунка и материјала за испуну као филтрациони слој.

Корак 3. Урадити први слој затрпавања дебљине 22cm. На месту близу зида у кругу од 1,50m, користити мали ваљак или ручне вибро плоче за сабијање испуне. За сабијање испуне преко 1,50m може се користити тежи ваљкасти компактор.

Корак 4. Исећи геомрежу на потребну дужину према цртежу (L+0.3m, где је L ефективна дужина између два ребра), а затим поставити геомрежу у V-жлеб бетонског блока и повезати са блоком помоћу посебног пластичног конектора.

Корак 5. Поставите други и трећи слој блокова на први слој, уметнути доњи језичак доње

површине у жлеб горње површине, обраћајући посебну пажњу на његово уздужно поравнање како би горња страна била потпуно равна.

Осигурати да други слој блокова буде притиснут на први слој геомреже, истовремено осигуравајући да је конектор закључан и чврсто повезан. Затегнути геомрежу хоризонтално уназад да не би дошло до опуштања или деформације.

Корак 6. Напунити и сабити други слој испуне дебљине 44cm. Сабити у два слоја (сваки слој 22cm) до врха трећег блока.

Корак 7. Исећи други слој арматуре геомреже на унапред одређену дужину према величини на цртежу и поновити 4. корак.

Корак 8. Наставити понављање претходних корака постављањем блокова и геомрежа у исправне положаје док се не достигне пројектована висина и заврши изградња зида.

Конкретни захтеви

Бетон који се користи за потпорни зид од армиране земље мора да испуњава следеће захтеве:

— За тампон (тампонски слој) темеља, бетон треба да буде минимумн C30/37, водоотпорност V-I и отпорност на смрзавање *XF3*.

— За декоративну фасаду (блокове) користити префабриковане комаде. Бетон треба да буде минимум C30/37, отпорност на воду V-I и отпорност на смрзавање *XF3*.

Belgrade, April 2021

Responsible Design Engineer:

Зоран Луковић, дипл.грађ.инж

license No.: 310 3032 03

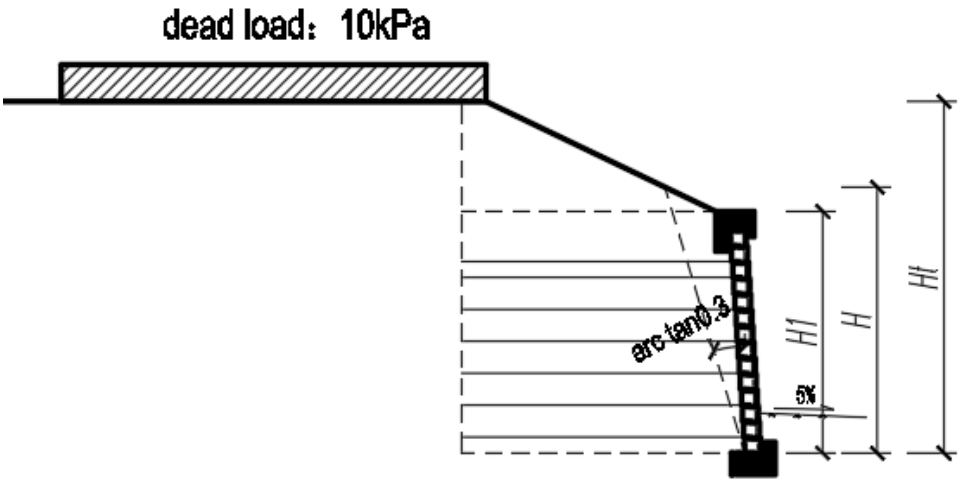
2/4.1.6 НУМЕРИЧКА ДОКУМЕНТАЦИЈА

2/4.1.6.1 Анализа конструкције

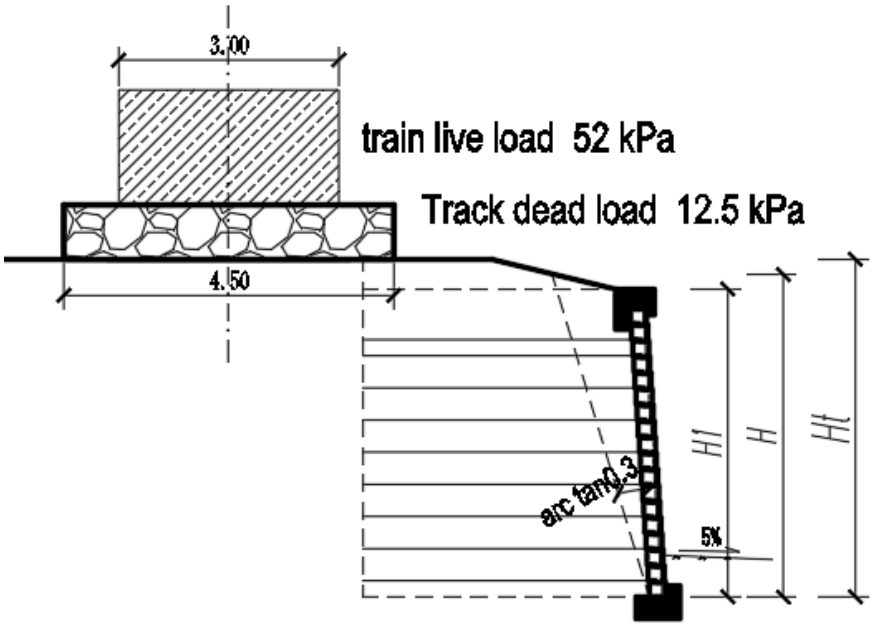
2/4-1.6.1 Анализа конструкције

Геометрија конструкције и модел оптерећења

（km77+000～km77+178）



（km77+178～km77+325）



Belgrade, April 2021

Responsible Design Engineer:
Зоран Луковић, дипл.грађ.инж
лиценца број: / license No.: 310 3032 03

_____

AASHTO 2007 (LRFD)
km77+000（Combination A）

PROJECT IDENTIFICATION

Title: km77+000（Combination A）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+000（Combination A）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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SOIL DATA

REINFORCED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 33.0 °

RETAINED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)
Equivalent unit weight, $\gamma_{equiv.}$ 18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$ 31.0 °
Equivalent cohesion, $c_{equiv.}$ 0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, Ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.4189 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 32.67 N γ= 25.99

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.4013 Kae (Kh = 0) = 0.3773 Δ Kae = 0.0240 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

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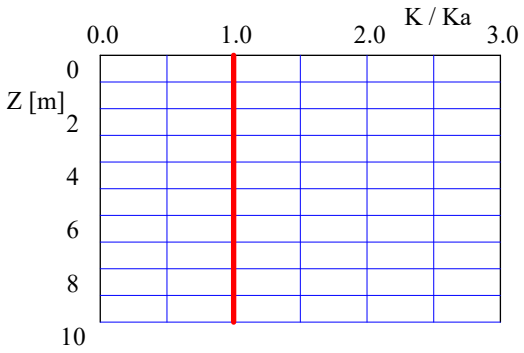
INPUT DATA: Geogrids (Analysis)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	N/A	N/A			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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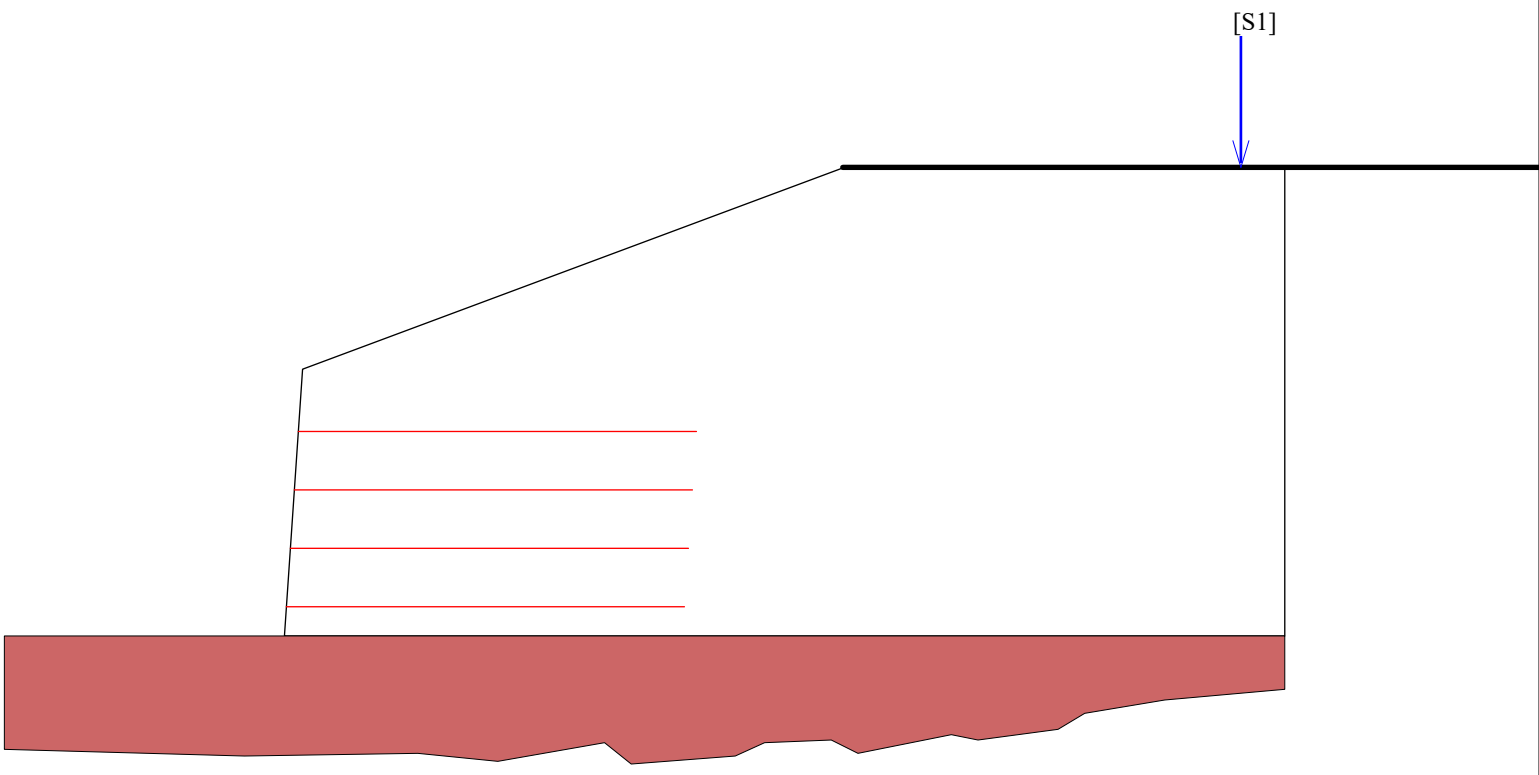
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	2.01	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 2.01 m }
Batter, ω	3.9	[deg]	
Backslope, β	20.4	[deg]	
Backslope rise	1.5	[m]	Broken back equivalent angle, I = 20.42° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 10.0 and Qv-l = 0.0 [kPa].
Footing width, b=6.0 [m]. Distance of center of footing from wall face, d = 7.1 [m] @ depth of 0.0 [m] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.50		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.50		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.77		0.90

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.50	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.50	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.50

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	0.83		0.90
Reinforced Soil and Reinforcement	ϕ_τ	0.77		0.90

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
	ϕ_b	0.74		0.90

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ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 6.53, Meyerhof stress = 80.66 kPa.
Foundation Interface: Direct sliding, CDR = 2.024, Eccentricity, e/L = -0.0064, CDR-overturning = 7.20

GEOGRID				CONNECTION							
#	Elevation [m]	Length [m]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	3.00	1	N/A	N/A	N/A	3.888	9.180	1.651	-0.0163	---RW-95
2	0.66	3.00	1	N/A	N/A	N/A	4.949	8.984	1.871	-0.0362	---RW-95
3	1.10	3.00	1	N/A	N/A	N/A	6.808	8.999	2.186	-0.0581	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	8.382	7.536	2.549	-0.0894	---RW-95

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, CDR = 11.97, Meyerhof stress = 53.82 kPa.
Foundation Interface: Direct sliding, CDR = 2.010, Eccentricity, e/L = 0.0000, Fs-overturning = 6.61

GEOGRID				CONNECTION							
#	Elevation [m]	Length [m]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	3.00	1	N/A	N/A	N/A	3.790	8.116	1.776	-0.0114	---RW-95
2	0.66	3.00	1	N/A	N/A	N/A	4.803	7.865	2.042	-0.0338	---RW-95
3	1.10	3.00	1	N/A	N/A	N/A	6.554	7.746	2.449	-0.0571	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	8.032	6.422	2.941	-0.0891	---RW-95

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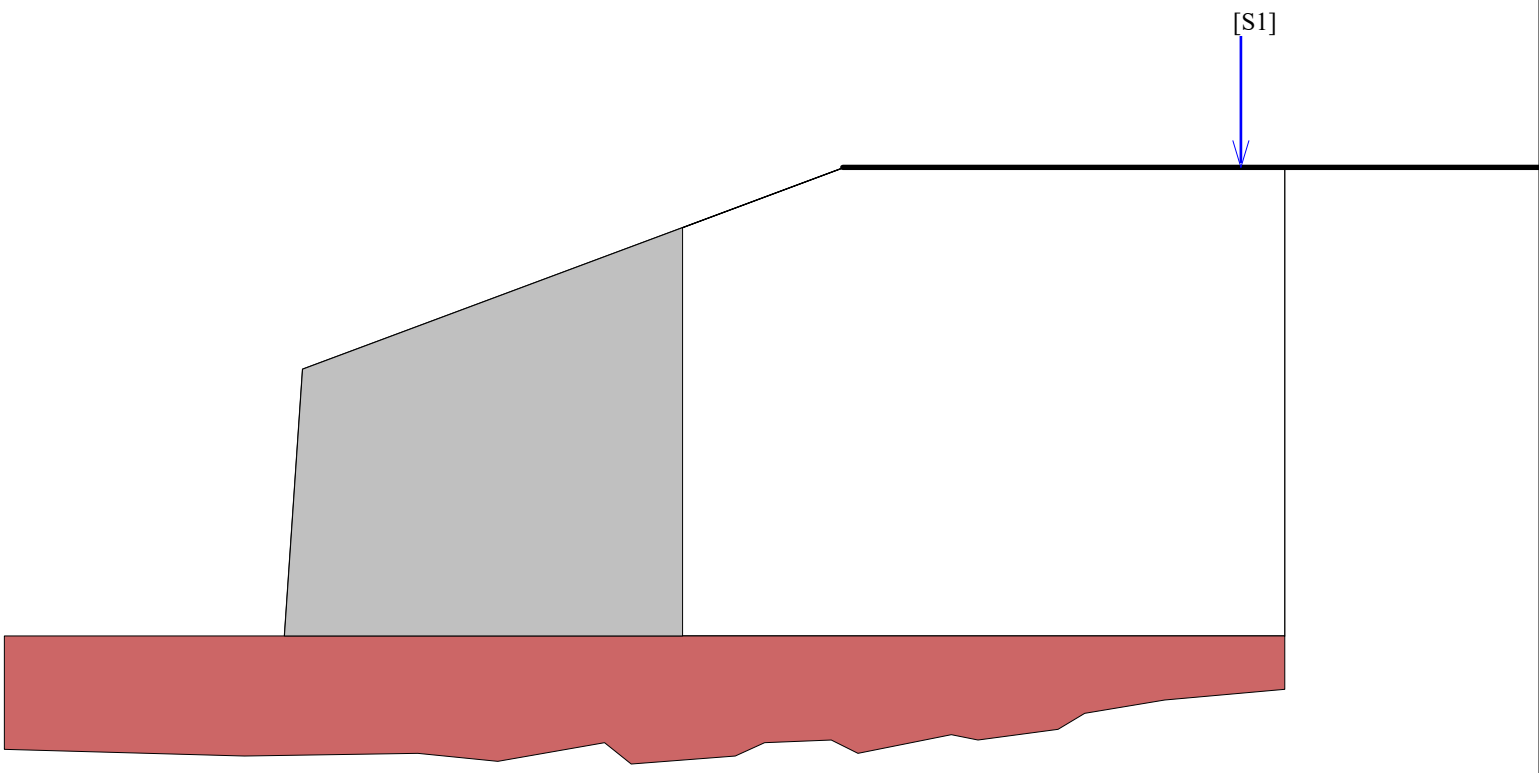
BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	527.0	644.1	[kPa]
Meyerhof stress, σ_V	80.66	53.8	[kPa]
Eccentricity, e	-0.02	0.01	[m]
Eccentricity, e/L	-0.006	0.004	
CDR calculated	6.53	11.97	
Base length	3.00	3.00	[m]



SCALE:

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DIRECT SLIDING for GIVEN LAYOUT
(for GEOGRID reinforcements)

Along reinforced and foundation soils interface: CDR-static = 2.024 and CDR-seismic = 2.010

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	3.00	1.651	1.776	1	---RW-95
2	0.66	3.00	1.871	2.042	1	---RW-95
3	1.10	3.00	2.186	2.449	1	---RW-95
4	1.54	3.00	2.549	2.941	1	---RW-95

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = -0.0064, e/L seismic = 0.0000; Overturning: CDR-static = 7.20, CDR-seismic = 6.61

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	3.00	-0.0163	-0.0114	1	---RW-95
2	0.66	3.00	-0.0362	-0.0338	1	---RW-95
3	1.10	3.00	-0.0581	-0.0571	1	---RW-95
4	1.54	3.00	-0.0894	-0.0891	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	7.79	0.45	N/A	3.888	N/A	3.790	---RW-95
2	0.66	30.3	6.12	0.42	N/A	4.949	N/A	4.803	---RW-95
3	1.10	30.3	4.45	0.38	N/A	6.808	N/A	6.554	---RW-95
4	1.54	30.3	3.61	0.35	N/A	8.382	N/A	8.032	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	7.79	0.45	2.90	0.10	71.5	N/A	9.180	66.8	N/A	8.116
2	0.66	1.000	6.12	0.42	2.69	0.31	54.9	N/A	8.984	51.4	N/A	7.865
3	1.10	1.000	4.45	0.38	2.48	0.52	40.0	N/A	8.999	37.4	N/A	7.746
4	1.54	1.000	3.61	0.35	2.27	0.73	27.2	N/A	7.536	25.4	N/A	6.422

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AASHTO 2007 (LRFD)
km77+000（Combination B）

PROJECT IDENTIFICATION

Title: km77+000（Combination B）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+000（Combination B）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: DESIGN
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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DESIGN DATA

DESIGN OBJECTIVES

Minimum Capacity Demand Ratio in pullout, CDR-po	1.10
Minimum Capacity Demand Ratio in direct sliding, CDR-sliding	1.10
Maximum allowable eccentricity ratio at each reinforcement level, e/L	0.2500
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-static	1.30
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-seismic	1.10

Prescribed minimum resistive length to prevent pullout, Le = 1.00 m.
Prescribed minimum normalized length of each layer is: L/Hd = 0.70 --> L = 1.41 m.
Prescribed minimum absolute total length of each layer is: L = 3.00 m.

BEARING CAPACITY

Bearing capacity is controlled by general shear.	
Maximum permissible eccentricity ratio (soil), e/L	0.2500
Min. Capacity Demand Ratio with respect to ultimate bearing capacity (Meyerhof approach)	1.10

Bearing capacity coefficients: Nc = 32.67 N γ= 25.99

SOIL DATA

REINFORCED SOIL

Unit weight, γ	19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ	33.0 °

RETAINED SOIL

Unit weight, γ	19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	31.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.4189 (if batter is less than 10°Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.4013 Kae (Kh = 0) = 0.3773 Δ Kae = 0.0240 (see eq. 37 in DEMO 82)

DIRECT SLIDING / ECCENTRICITY
Seismic CDR is 100.0% of specified static CDR for direct sliding.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

BEARING CAPACITY
Seismic CDR is 100.0% of specified static CDR for bearing capacity.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

INTERNAL STABILITY
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.
Seismic Capacity Demand Ratio in pullout, CDR-po, is 100.0% of its specified static value.
Seismic Capacity Demand Ratio, CDR-overall, is 100.0% of its specified static value.
The reduction of CDR pertains to geogrid strength and to connection strength for break mode of failure.

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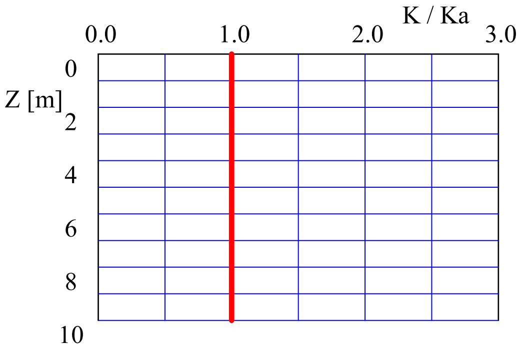
INPUT DATA: Geogrids
(Multiple type reinforcement)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	1.00	1.00			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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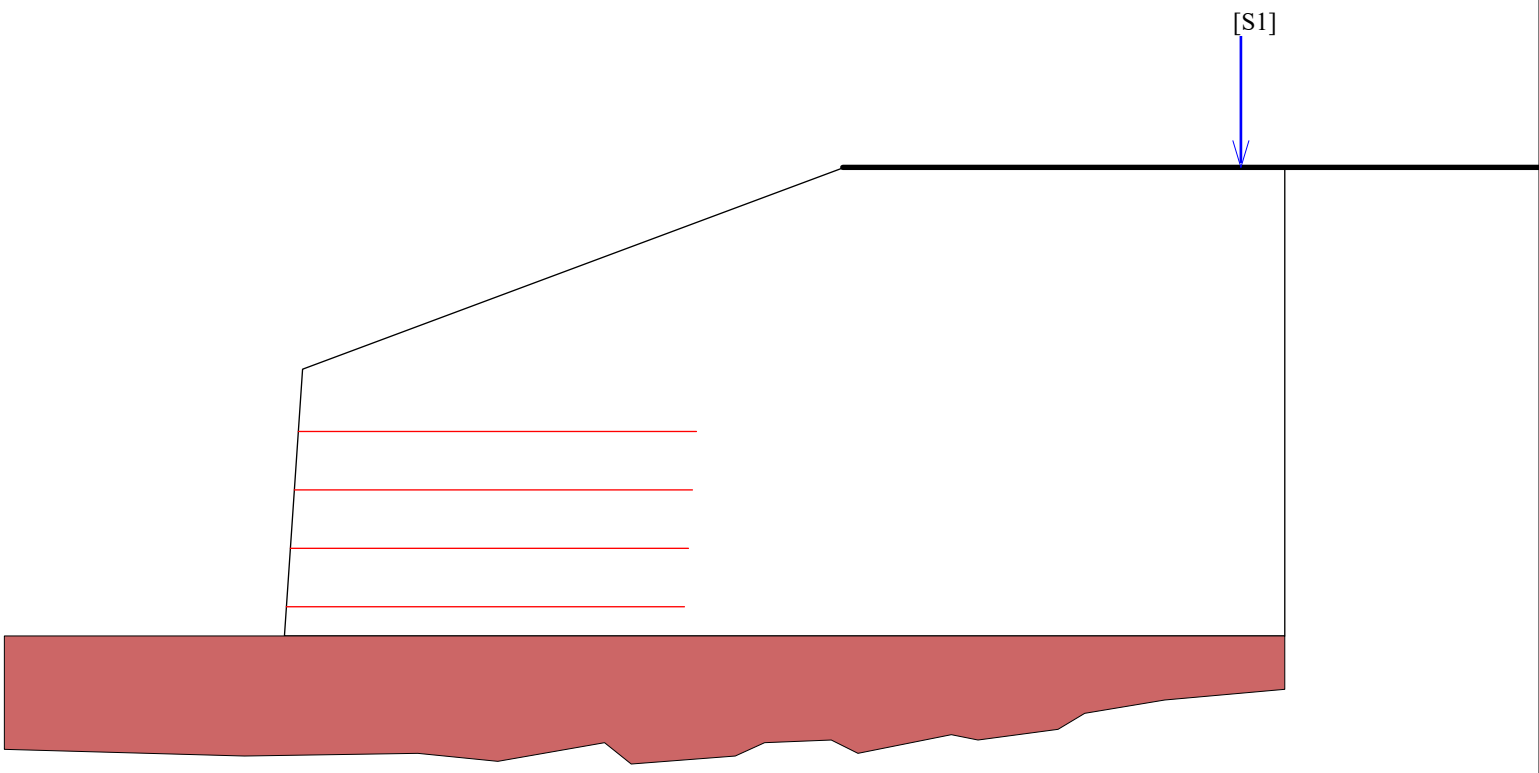
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	2.01	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 2.01 m }
Batter, ω	3.9	[deg]	
Backslope, β	20.4	[deg]	
Backslope rise	1.5	[m]	Broken back equivalent angle, I = 20.42° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 10.0 and Qv-l = 0.0 [kPa].
Footing width, b=6.0 [m]. Distance of center of footing from wall face, d = 7.1 [m] @ depth of 0.0 [m] below soil surface.

DESIGNED REINFORCEMENT LAYOUT:



SCALE:

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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.00		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.00		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.00		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.77		0.90

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	0.83		0.90
Reinforced Soil and Reinforcement	ϕ_τ	0.77		0.90

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
	ϕ_b	0.74		0.90

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REINFORCEMENT LAYOUT AND DESIGN CRITERIA

LEGEND: (1) Connection strength √ Satisfactory
(2) Geogrid strength ⊗ Unsatisfactory
(3) Pullout resistance
(4) Direct sliding
(5) Eccentricity

Bearing capacity: √
Foudation Interface: Direct sliding √ Eccentricity √

#	Geogrid Elevation [m]	Length [m]	Type #	(1)	(2)	(3)	(4)	(5)
1	0.22	3.00	1	N/A	√	√	√	√
2	0.66	3.00	1	N/A	√	√	√	√

#	Geogrid Elevation [m]	Length [m]	Type #	(1)	(2)	(3)	(4)	(5)
3	1.10	3.00	1	N/A	√	√	√	√
4	1.54	3.00	1	N/A	√	√	√	√

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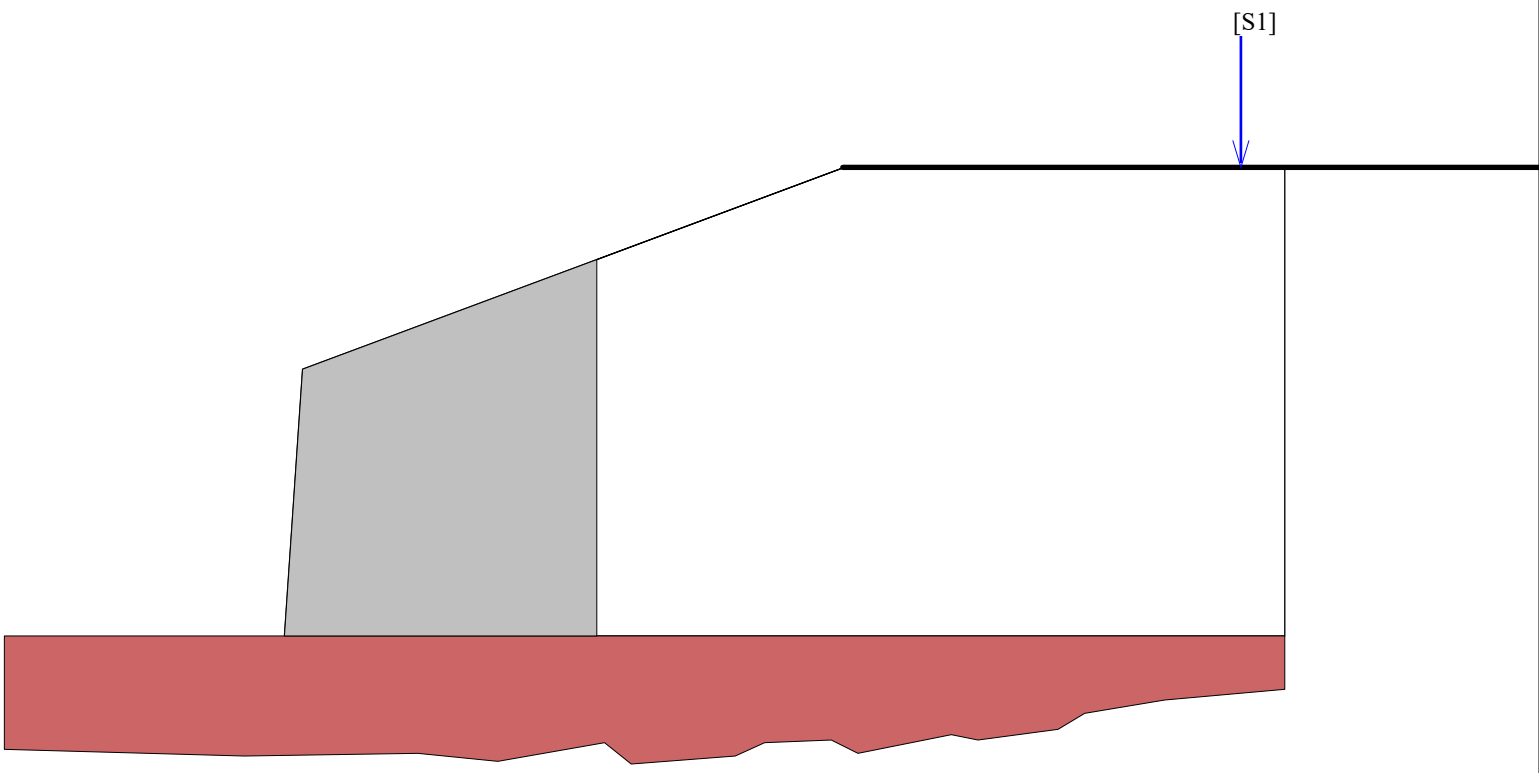
BEARING CAPACITY for DESIGNED LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	383.0	484.8	[kPa]
Meyerhof stress, σ_V	57.89	53.2	[kPa]
Eccentricity, e	0.10	0.06	[m]
Eccentricity, e/L	0.043	0.024	
CDR calculated	6.62	9.12	
Base length	2.35	2.35	[m]



SCALE:

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DIRECT SLIDING for DESIGNED LAYOUT
(for GEOGRID reinforcements)

Specified CDR-static = 1.100 and CDR-seismic = 1.100

Along reinforced and foundation soils interface: CDR-static = 1.346 and CDR-seismic = 1.993

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	3.00	1.174	1.864	1	---RW-95
2	0.66	3.00	1.320	2.127	1	---RW-95
3	1.10	3.00	1.518	2.506	1	---RW-95
4	1.54	3.00	1.747	2.954	1	---RW-95

ECCENTRICITY for DESIGNED LAYOUT

At interface with foundation: e/L static = 0.0428, e/L seismic = 0.0237; Overturning: CDR-static = 4.07, CDR-seismic = 5.31

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	3.00	-0.0020	-0.0130	1	---RW-95
2	0.66	3.00	-0.0271	-0.0343	1	---RW-95
3	1.10	3.00	-0.0533	-0.0572	1	---RW-95
4	1.54	3.00	-0.0878	-0.0892	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	5.2	0.4	1.000	5.832	1.000	5.615	---RW-95
2	0.66	30.3	4.1	0.4	1.000	7.424	1.000	7.099	---RW-95
3	1.10	30.3	3.0	0.4	1.000	10.211	1.000	9.651	---RW-95
4	1.54	30.3	2.4	0.4	1.000	12.574	1.000	11.801	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	5.19	0.45	2.90	0.10	71.5	1.100	13.769	66.8	1.100	11.851
2	0.66	1.000	4.08	0.42	2.69	0.31	54.9	1.100	13.476	51.4	1.100	11.434
3	1.10	1.000	2.96	0.38	2.48	0.52	40.0	1.100	13.498	37.4	1.100	11.176
4	1.54	1.000	2.41	0.35	2.27	0.73	27.2	1.100	11.304	25.4	1.100	9.224

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AASHTO 2007 (LRFD)
km77+000（Combination C）

PROJECT IDENTIFICATION

Title: km77+000（Combination C）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+000（Combination C）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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SOIL DATA

REINFORCED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 33.0 °

RETAINED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)
Equivalent unit weight, $\gamma_{equiv.}$ 18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$ 31.0 °
Equivalent cohesion, $c_{equiv.}$ 0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10°Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.4189 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 32.67 N γ= 25.99

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.4013 Kae (Kh = 0) = 0.3773 Δ Kae = 0.0240 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

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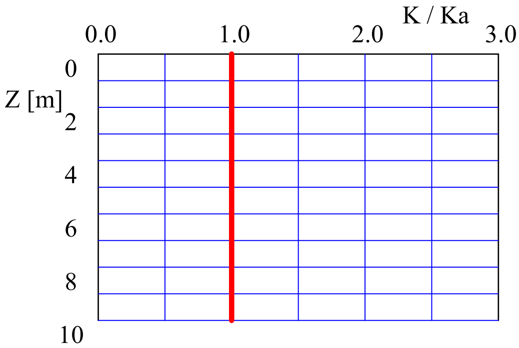
INPUT DATA: Geogrids
(Analysis)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	N/A	N/A			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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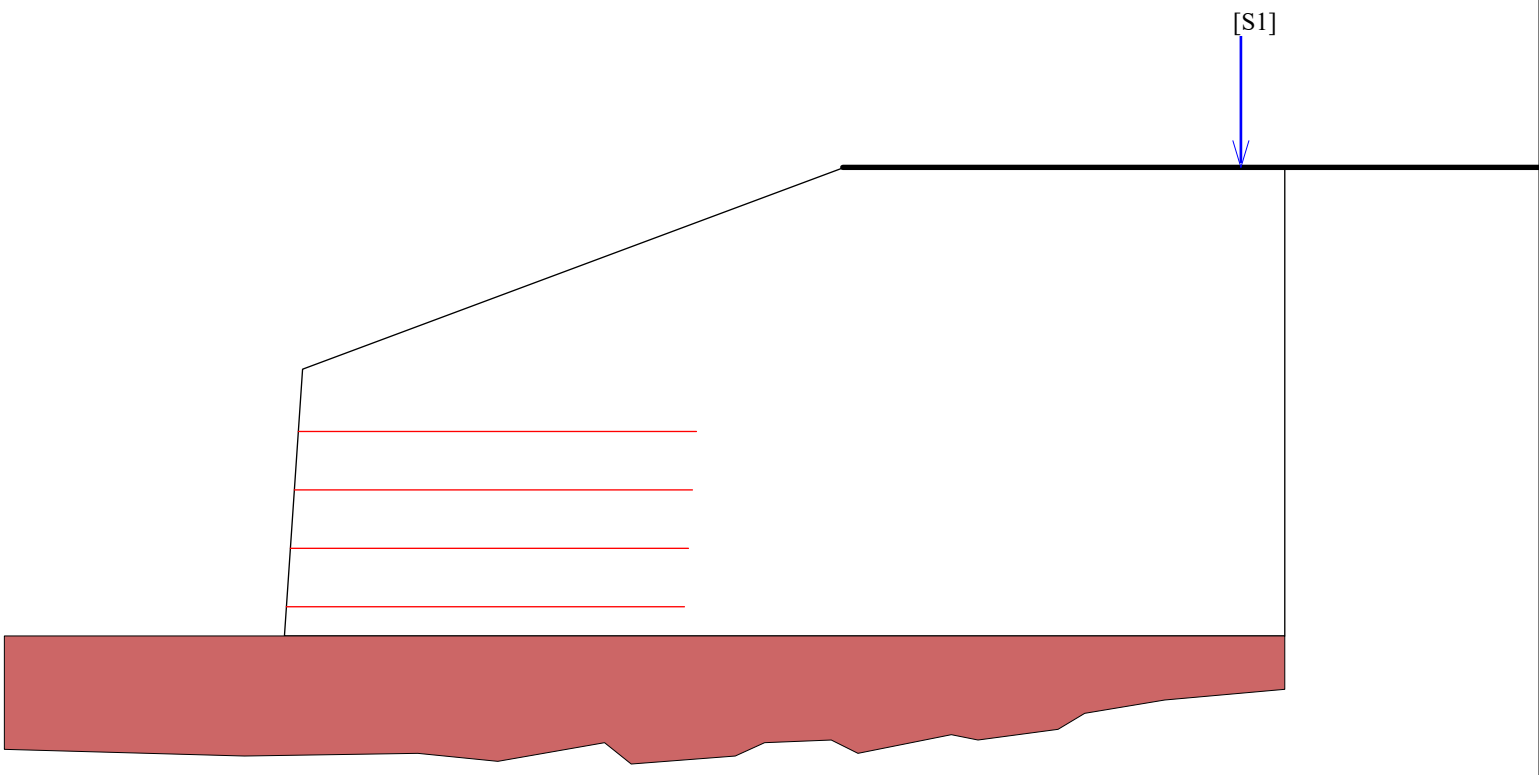
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	2.01	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 2.01 m }
Batter, ω	3.9	[deg]	
Backslope, β	20.4	[deg]	
Backslope rise	1.5	[m]	Broken back equivalent angle, I = 20.42° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 10.0 and Qv-l = 0.0 [kPa].
Footing width, b=6.0 [m]. Distance of center of footing from wall face, d = 7.1 [m] @ depth of 0.0 [m] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.00		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.00		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.00		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	1.00

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	1.00	1.00

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.00
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic
	ϕ_b	1.00	1.00

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ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 13.24, Meyerhof stress = 53.77 kPa.
Foundation Interface: Direct sliding, CDR = 2.438, Eccentricity, e/L = -0.0064, CDR-overturning = 7.20

GEOGRID				CONNECTION							
#	Elevation [m]	Length [m]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	3.00	1	N/A	N/A	N/A	5.832	17.882	2.144	-0.0163	---RW-95
2	0.66	3.00	1	N/A	N/A	N/A	7.424	17.501	2.430	-0.0362	---RW-95
3	1.10	3.00	1	N/A	N/A	N/A	10.211	17.530	2.838	-0.0581	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	12.574	14.680	3.310	-0.0894	---RW-95

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, CDR = 13.47, Meyerhof stress = 53.37 kPa.
Foundation Interface: Direct sliding, CDR = 2.349, Eccentricity, e/L = -0.0022, Fs-overturning = 6.87

GEOGRID				CONNECTION							
#	Elevation [m]	Length [m]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	3.00	1	N/A	N/A	N/A	6.238	13.168	2.071	-0.0130	---RW-95
2	0.66	3.00	1	N/A	N/A	N/A	7.888	12.705	2.363	-0.0343	---RW-95
3	1.10	3.00	1	N/A	N/A	N/A	10.724	12.417	2.784	-0.0572	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	13.113	10.249	3.282	-0.0892	---RW-95

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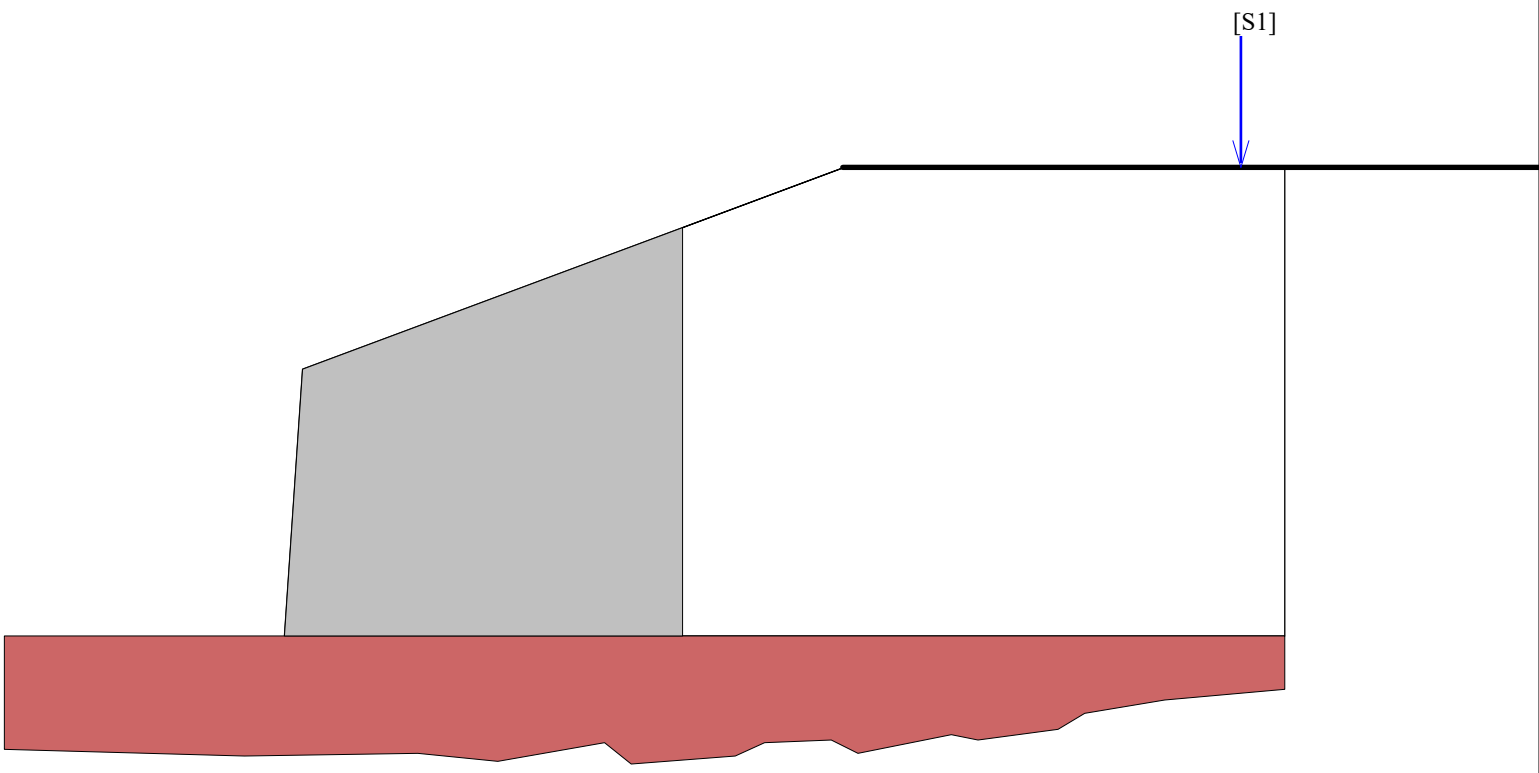
BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	712.1	718.7	[kPa]
Meyerhof stress, σ_V	53.77	53.4	[kPa]
Eccentricity, e	-0.02	-0.01	[m]
Eccentricity, e/L	-0.006	-0.002	
CDR calculated	13.24	13.47	
Base length	3.00	3.00	[m]



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DIRECT SLIDING for GIVEN LAYOUT (for GEOGRID reinforcements)

Along reinforced and foundation soils interface: CDR-static = 2.438 and CDR-seismic = 2.349

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	3.00	2.144	2.071	1	---RW-95
2	0.66	3.00	2.430	2.363	1	---RW-95
3	1.10	3.00	2.838	2.784	1	---RW-95
4	1.54	3.00	3.310	3.282	1	---RW-95

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = -0.0064, e/L seismic = -0.0022; Overturning: CDR-static = 7.20, CDR-seismic = 6.87

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	3.00	-0.0163	-0.0130	1	---RW-95
2	0.66	3.00	-0.0362	-0.0343	1	---RW-95
3	1.10	3.00	-0.0581	-0.0572	1	---RW-95
4	1.54	3.00	-0.0894	-0.0892	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	5.19	0.45	N/A	5.832	N/A	6.238	---RW-95
2	0.66	30.3	4.08	0.42	N/A	7.424	N/A	7.888	---RW-95
3	1.10	30.3	2.96	0.38	N/A	10.211	N/A	10.724	---RW-95
4	1.54	30.3	2.41	0.35	N/A	12.574	N/A	13.113	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	5.19	0.45	2.90	0.10	92.8	N/A	17.882	74.2	N/A	13.168
2	0.66	1.000	4.08	0.42	2.69	0.31	71.4	N/A	17.501	57.1	N/A	12.705
3	1.10	1.000	2.96	0.38	2.48	0.52	52.0	N/A	17.530	41.6	N/A	12.417
4	1.54	1.000	2.41	0.35	2.27	0.73	35.3	N/A	14.680	28.3	N/A	10.249

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77+000 overall stability(no seismicity）

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PROJECT IDENTIFICATION

Title: 77+000 overall stability(no seismicity）
Project Number: -
Client:
Designer: 戴征杰（BOSTD）

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia
,
Telephone #:
Fax #:
E-Mail:

Original file path and name:
Original date and time of creating this file: Thu Apr 08 16:08:38 2021

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0

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INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [kN/m^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [kPa]
1....... Reinforced Soil..................................	19.5	33.0	0.0
2...	20.0	28.0	0.0
3....... Foundation Soil.................................	18.5	31.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [kN/m]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Additional Reduction Factor, RFa	Coverage Ratio, Rc
1	---RW-95	95.70	1.16	1.10	2.23	1.00	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
1	---RW-95	0.77	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Not Applicable

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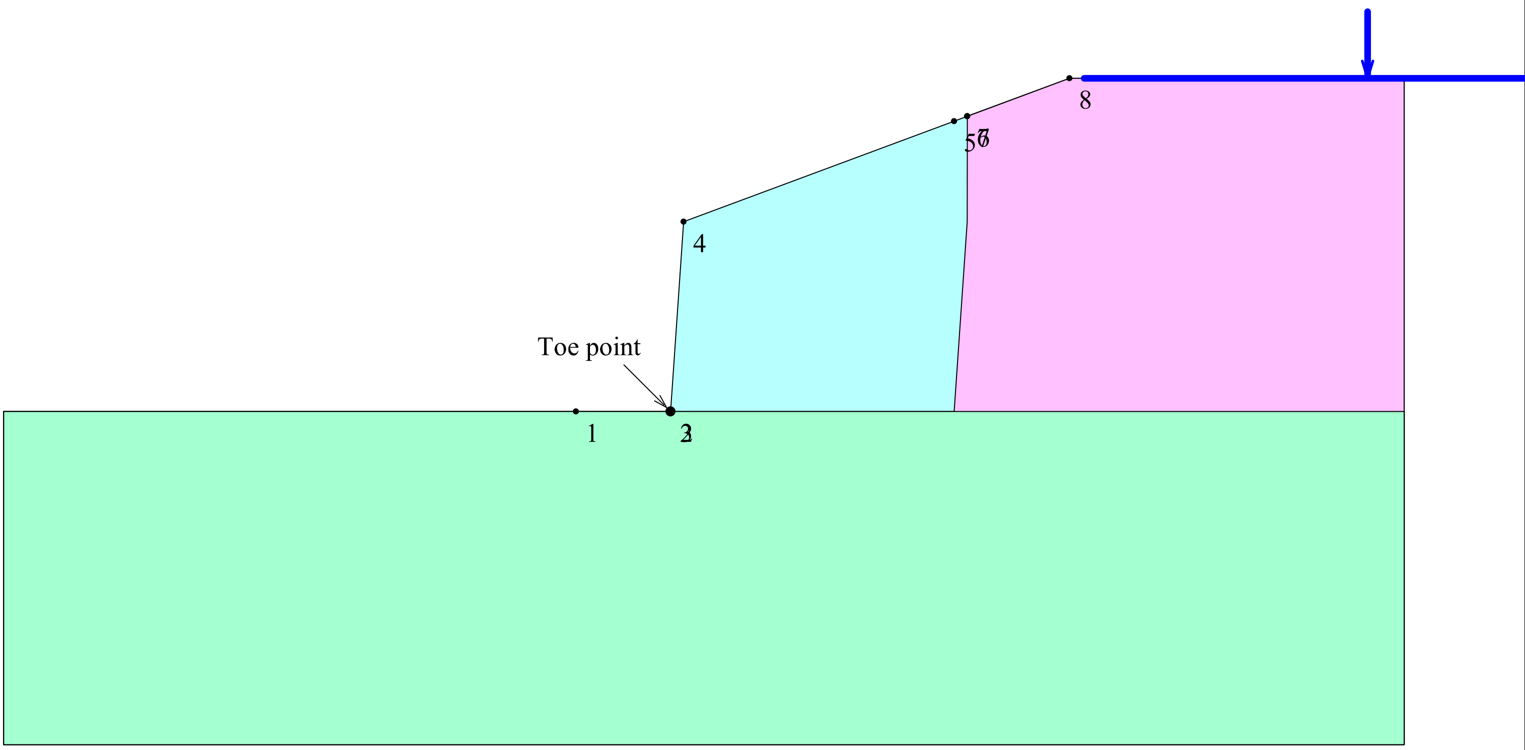
DRAWING OF SPECIFIED GEOMETRY - GENERAL - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE
Surcharge load, Q1....................................None
Surcharge load, Q2....................................None
Surcharge load, Q3....................................None

STRIP LOAD
Strip Load #1.. 10.00 [kPa] Width of base, b = 6.00 [m] Distance from toe point, d = 7.38 [m]



SCALE:

0 2 4 6 [m]

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TABULATED DETAILS OF GEMERAL SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

	#	Xi	Yi
Top of Layer 1	1	-1.00	0.00
	2	-0.00	0.00
	3	0.00	0.00
	4	0.14	2.01
	5	4.22	3.53
Top of Layer 2	6	-1.00	0.00
	7	-0.00	0.00
	8	0.00	0.00
	9	3.00	0.00
	10	3.14	2.01
	11	3.14	3.13
	12	4.22	3.53
Top of Layer 3	13	-1.00	0.00
	14	-0.00	0.00
	15	0.00	0.00

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TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

#	X	Y1	Y2	Y3
1	-1.00	0.00	0.00	0.00
2	-0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.14	2.01	0.00	0.00
5	3.00	3.08	0.00	0.00
6	3.14	3.13	2.01	0.00
7	3.14	3.13	3.13	0.00
8	4.22	3.53	3.53	0.00

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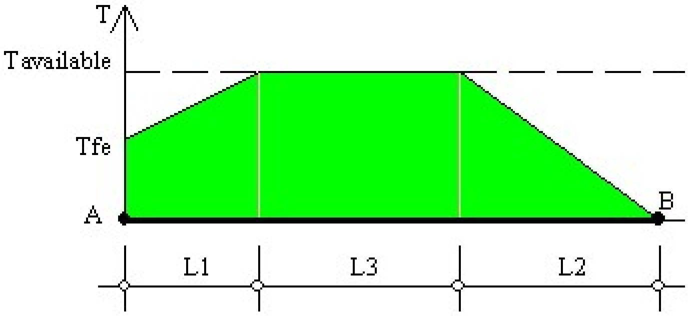
DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER



A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [m]	L [m]	L1 [m]	L2 [m]	L3 [m]	Tfe [kN/m]	Tavailable [kN/m]
1	---RW-95	0.22	3.00	0.00	1.44	1.56	33.63	33.63
2	---RW-95	0.66	3.00	0.00	1.77	1.23	33.63	33.63
3	---RW-95	1.10	3.00	0.00	2.39	0.61	33.63	33.63
4	---RW-95	1.54	3.00	0.00	3.00	0.00	27.45	27.45 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength.

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RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [m]		Exit Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	3.00	3.08	-4.35	0.03	-1.32	3.11	4.32	3.33	
2	3.53	3.27	-3.40	0.03	-0.70	3.29	4.23	2.18	
3	4.06	3.47	-2.94	0.04	-0.31	3.54	4.37	1.74	
4	4.59	3.53	-2.41	0.01	0.15	3.64	4.44	1.57	
5	5.12	3.53	-2.46	0.04	0.13	4.38	5.06	1.46	
6	5.65	3.53	-2.44	0.02	0.07	5.30	5.85	1.42	
. 7	6.18	3.53	-2.89	0.00	-0.16	6.41	6.96	1.41 .	OK
8	6.71	3.53	-2.95	0.03	-0.17	7.44	7.92	1.43	
9	7.24	3.53	-2.92	0.01	-0.23	8.67	9.07	1.47	
10	7.77	3.53	-3.44	0.02	-0.45	10.14	10.55	1.52	
11	8.30	3.53	-3.95	0.03	-0.80	12.19	12.56	1.58	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points).

Exit Point #	Exit Point (X, Y) [m]		Entry Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	-4.84	0.02	6.71	3.53	-1.14	8.61	9.36	1.49	
2	-4.32	0.00	6.18	3.53	-0.86	7.09	7.89	1.46	
3	-3.89	0.03	6.18	3.53	-0.63	6.88	7.59	1.43	
4	-3.45	0.04	6.18	3.53	-0.40	6.65	7.28	1.42	
. 5	-2.89	0.00	6.18	3.53	-0.16	6.41	6.96	1.41 .	OK
6	-2.41	0.00	6.18	3.53	0.09	6.15	6.64	1.41	
7	-2.00	0.03	6.18	3.53	0.27	6.03	6.41	1.43	
8	-1.48	0.01	6.18	3.53	0.53	5.73	6.06	1.46	
9	-1.01	0.02	6.18	3.53	0.74	5.55	5.81	1.50	
10	-0.55	0.02	6.71	3.53	0.87	6.34	6.48	1.57	
11	-0.00	0.00	6.71	3.53	1.07	6.10	6.19	1.63	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

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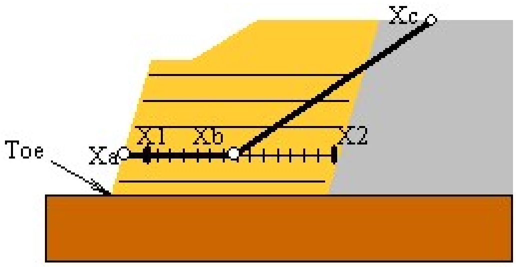
RESULTS OF TRANSLATIONAL ANALYSIS



Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [m]	(Xa, Ya) [m]		(Xb, Yb) [m]		(Xc, Yc) [m]		Fs	STATUS
At toe elevation	0.00	0.00	0.00	2.80	0.00	7.48	3.53	1.66	Minimum on Edge
. Reinf. Layer #1	0.22	0.02	0.22	2.99	0.22	7.08	3.53	1.57	Minimum on Edge
Reinf. Layer #2	0.66	0.05	0.66	2.99	0.66	6.66	3.53	1.62	Minimum on Edge
Reinf. Layer #3	1.10	0.08	1.10	3.09	1.10	6.20	3.53	1.66	Minimum on Edge
Reinf. Layer #4	1.54	0.11	1.54	3.09	1.54	5.83	3.53	1.72	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

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CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.41

Critical Circle: Xc = -0.16[m], Yc = 6.41[m], R = 6.96[m]. (Number of slices used = 57)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

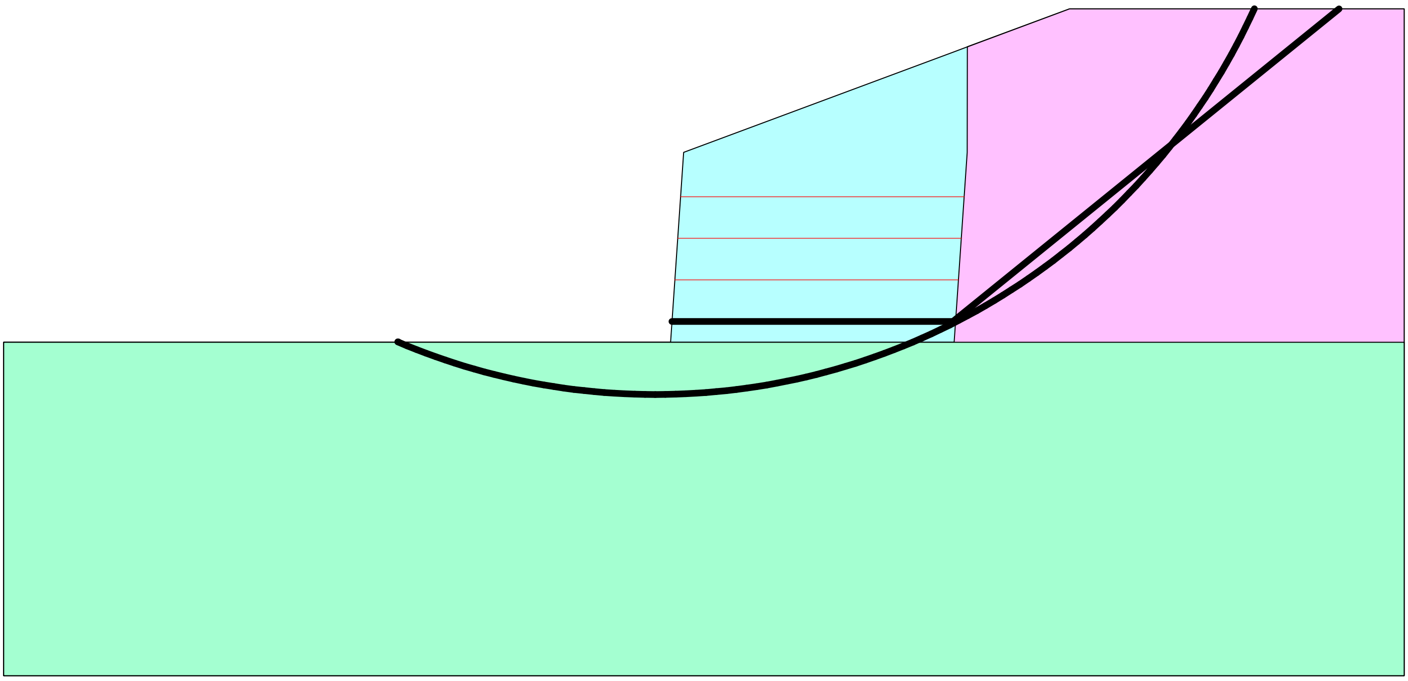
Minimum Factor of Safety = 1.57

Critical Two-Part Wedge: (Xa = 0.02, Ya = 0.22) [m]
(Xb = 2.99, Yb = 0.22) [m]
(Xc = 7.08, Yc = 3.53) [m]
(Number of slices used = 30)
Interslice resultant force inclination = 24.27 [degrees]

Three-Part Wedge Stability Analysis

N O T C O N D U C T E D

REINFORCEMENT LAYOUT: DRAWING



SCALE:

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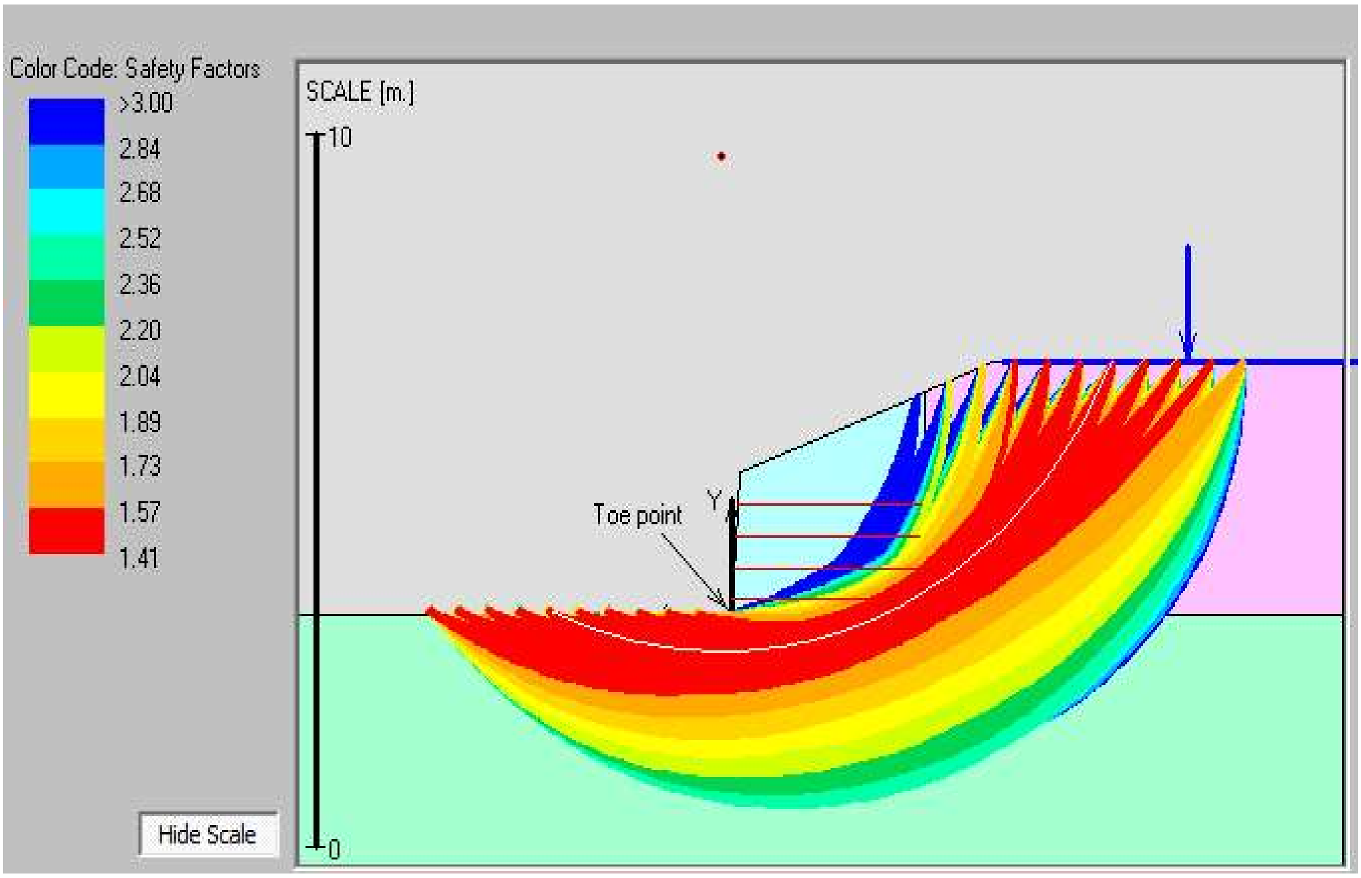
SAFETY MAP: BISHOP ROTATIONAL ANALYSIS MODE



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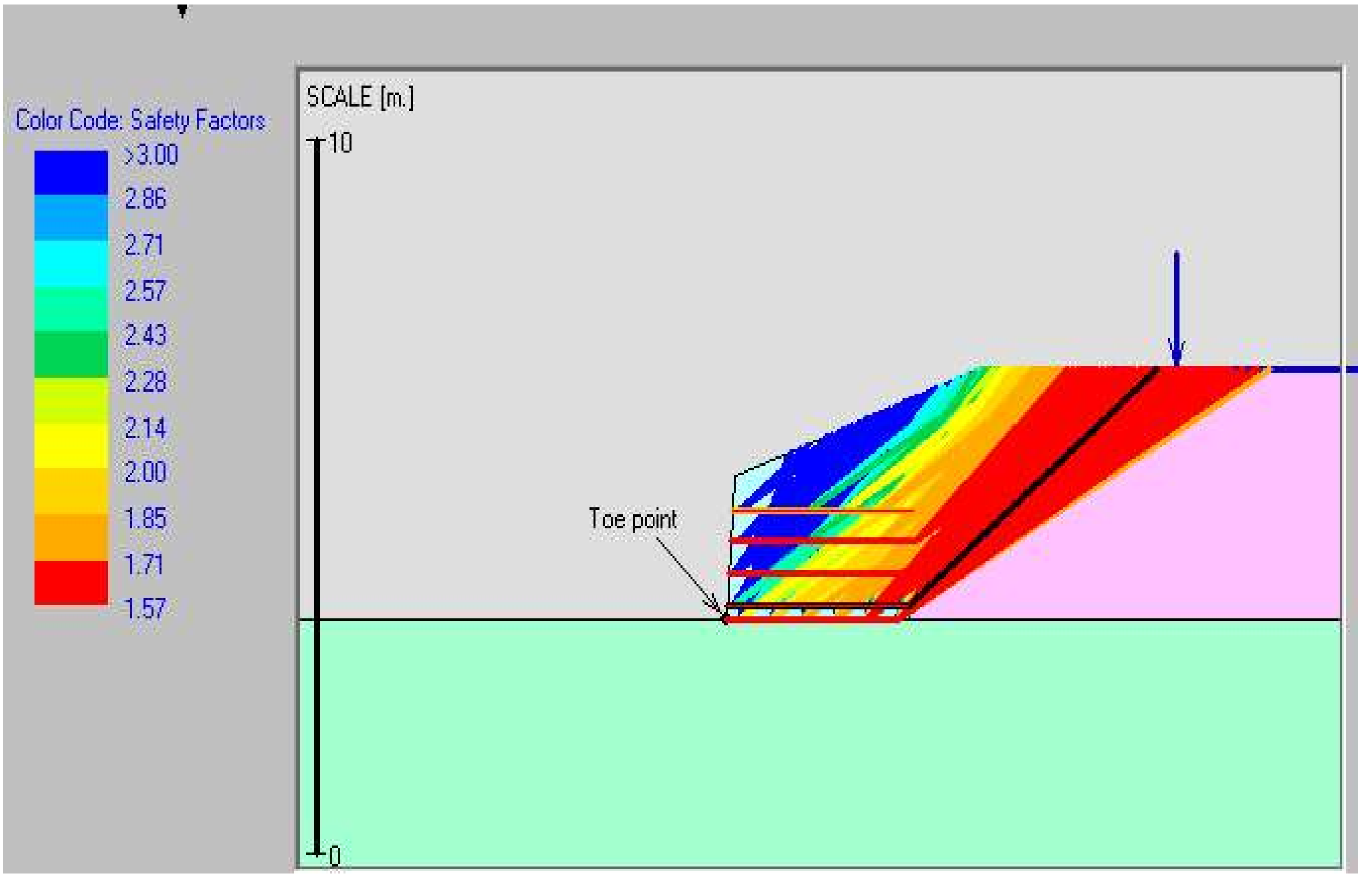
SAFETY MAP: SPENCER TRANSLATIONAL, 2-PART WEDGE



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77+000 overall stability(seismicity）

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PROJECT IDENTIFICATION

Title: 77+000 overall stability(seismicity）
Project Number: -
Client:
Designer: 戴征杰（BOSTD）

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia
,
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+000 overall stability.MSE
Original date and time of creating this file: Thu Apr 08 16:08:38 2021

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

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INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

========== Soil Layer #: ==========	Unit weight, γ [kN/m^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [kPa]
1..... Reinforced Soil.....	19.5	33.0	0.0
2.....	20.0	28.0	0.0
3..... Foundation Soil.....	18.5	31.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [kN/m]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Additional Reduction Factor, RFa	Coverage Ratio, Rc
1	---RW-95	95.70	1.16	1.10	2.23	1.00	1.00

Interaction Parameters		== Direct Sliding ==		==== Pullout ====	
Type #	Geosynthetic Designated Name	Cds-phi	Cds-c	Ci	Alpha
1	---RW-95	0.77	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Horizontal peak ground acceleration coefficient, Ao = 0.140
Design horizontal seismic coefficient, kh = Am = 0.50 x Ao = 0.070 & design vertical seismic coefficient, kv (down) = 0.000 x kh = 0.000

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DRAWING OF SPECIFIED GEOMETRY - GENERAL - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

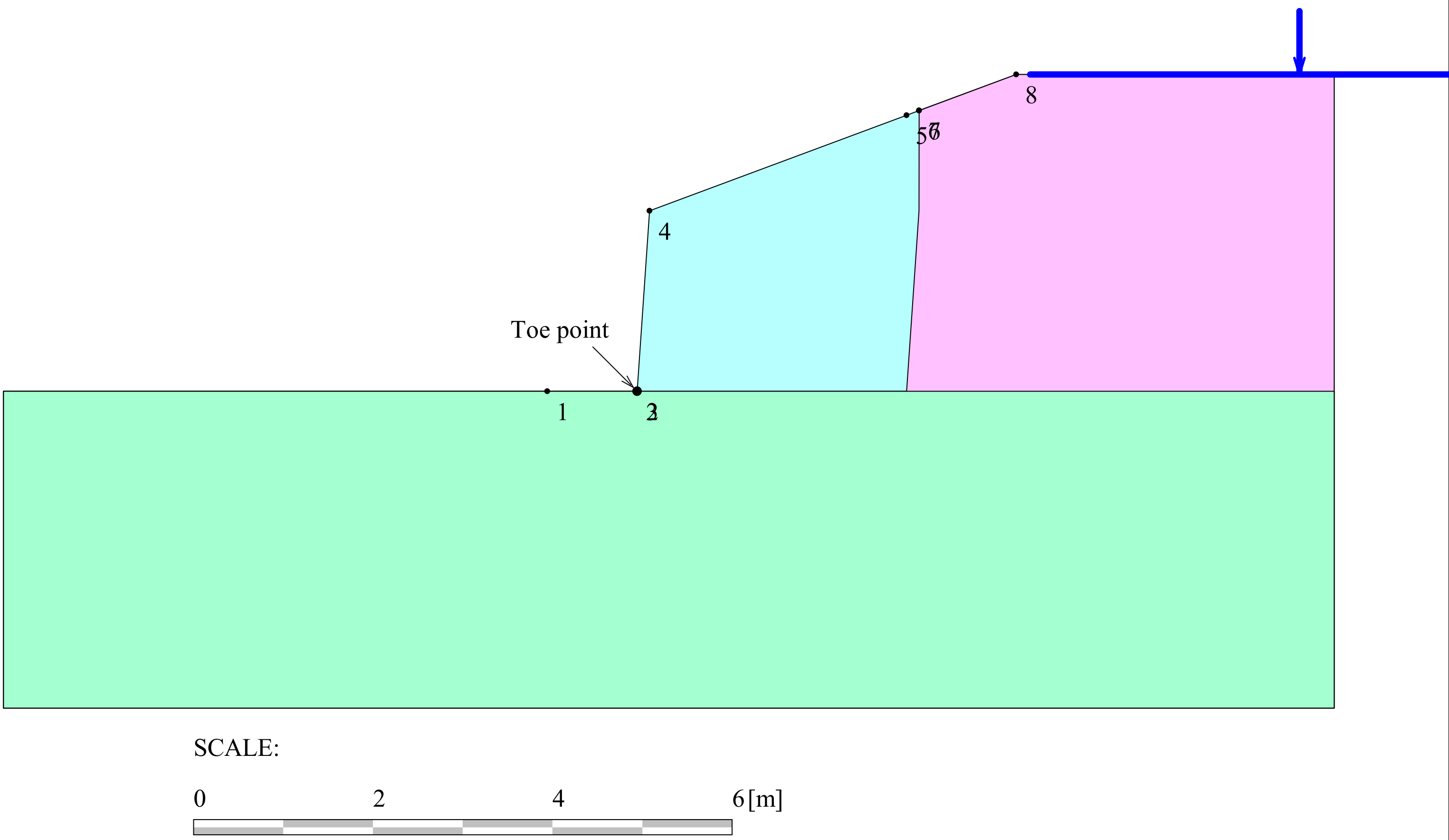
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Surcharge load, Q1....................................None
Surcharge load, Q2....................................None
Surcharge load, Q3....................................None

STRIP LOAD

Strip Load #1.. 10.00 [kPa]   Width of base, b = 6.00 [m] Distance from toe point, d = 7.38 [m]



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TABULATED DETAILS OF GEMERAL SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

	#	Xi	Yi
Top of Layer 1	1	-1.00	0.00
	2	-0.00	0.00
	3	0.00	0.00
	4	0.14	2.01
	5	4.22	3.53
Top of Layer 2	6	-1.00	0.00
	7	-0.00	0.00
	8	0.00	0.00
	9	3.00	0.00
	10	3.14	2.01
	11	3.14	3.13
	12	4.22	3.53
Top of Layer 3	13	-1.00	0.00
	14	-0.00	0.00
	15	0.00	0.00

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TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

#	X	Y1	Y2	Y3
1	-1.00	0.00	0.00	0.00
2	-0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.14	2.01	0.00	0.00
5	3.00	3.08	0.00	0.00
6	3.14	3.13	2.01	0.00
7	3.14	3.13	3.13	0.00
8	4.22	3.53	3.53	0.00

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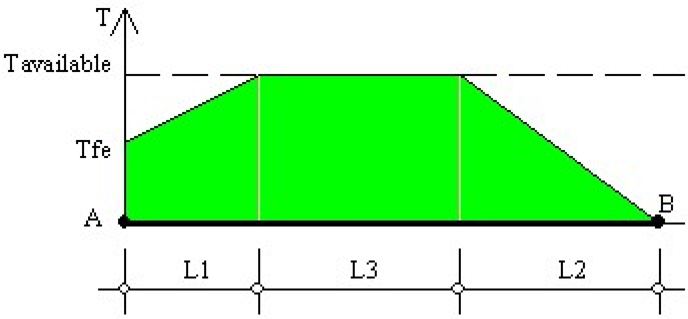
DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER



A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [m]	L [m]	L1 [m]	L2 [m]	L3 [m]	Tfe [kN/m]	Tavailable [kN/m]
1	---RW-95	0.22	3.00	0.00	1.44	1.56	33.63	33.63
2	---RW-95	0.66	3.00	0.00	1.77	1.23	33.63	33.63
3	---RW-95	1.10	3.00	0.00	2.39	0.61	33.63	33.63
4	---RW-95	1.54	3.00	0.00	3.00	0.00	27.45	27.45 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength.

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RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [m]		Exit Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	3.00	3.08	-4.35	0.03	-1.32	3.11	4.32	2.73	
2	3.53	3.27	-3.40	0.03	-0.70	3.29	4.23	1.89	
3	4.06	3.47	-2.94	0.04	-0.31	3.54	4.37	1.53	
4	4.59	3.53	-2.41	0.01	0.03	3.88	4.58	1.40	
5	5.12	3.53	-2.46	0.04	0.13	4.38	5.06	1.30	
6	5.65	3.53	-2.44	0.02	0.07	5.30	5.85	1.25	
. 7	6.18	3.53	-2.89	0.00	-0.16	6.41	6.96	1.23 .	OK
8	6.71	3.53	-2.95	0.03	-0.17	7.44	7.92	1.24	
9	7.24	3.53	-3.37	0.00	-0.45	8.95	9.41	1.27	
10	7.77	3.53	-3.87	0.01	-0.76	10.73	11.17	1.30	
11	8.30	3.53	-3.95	0.03	-0.80	12.19	12.56	1.34	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points).

Exit Point #	Exit Point (X, Y) [m]		Entry Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	-4.84	0.02	6.71	3.53	-1.14	8.61	9.36	1.28	
2	-4.38	0.03	6.71	3.53	-0.93	8.40	9.06	1.27	
3	-3.89	0.03	6.18	3.53	-0.63	6.88	7.59	1.25	
4	-3.45	0.04	6.18	3.53	-0.40	6.65	7.28	1.24	
. 5	-2.89	0.00	6.18	3.53	-0.16	6.41	6.96	1.23 .	OK
6	-2.41	0.00	6.18	3.53	0.09	6.15	6.64	1.24	
7	-2.00	0.03	6.18	3.53	0.27	6.03	6.41	1.25	
8	-1.48	0.01	6.18	3.53	0.53	5.73	6.06	1.28	
9	-1.01	0.02	6.18	3.53	0.74	5.55	5.81	1.32	
10	-0.55	0.02	6.71	3.53	0.87	6.34	6.48	1.36	
11	-0.00	0.00	6.71	3.53	1.07	6.10	6.19	1.42	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

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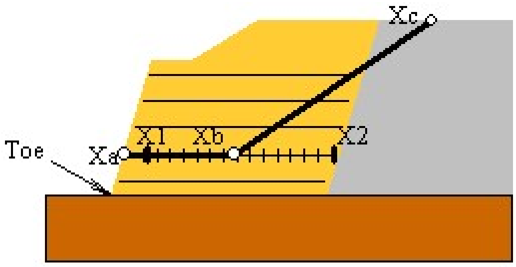
RESULTS OF TRANSLATIONAL ANALYSIS



Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [m]	(Xa, Ya) [m]		(Xb, Yb) [m]		(Xc, Yc) [m]		Fs	STATUS
At toe elevation	0.00	0.00	0.00	2.80	0.00	7.66	3.53	1.40	Minimum on Edge
. Reinf. Layer #1	0.22	0.02	0.22	2.99	0.22	7.23	3.53	1.31	Minimum on Edge
Reinf. Layer #2	0.66	0.05	0.66	2.99	0.66	6.66	3.53	1.36	Minimum on Edge
Reinf. Layer #3	1.10	0.08	1.10	3.09	1.10	6.20	3.53	1.38	Minimum on Edge
Reinf. Layer #4	1.54	0.11	1.54	3.09	1.54	5.83	3.53	1.42	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

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CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.23

Critical Circle: Xc = -0.16[m], Yc = 6.41[m], R = 6.96[m]. (Number of slices used = 57)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

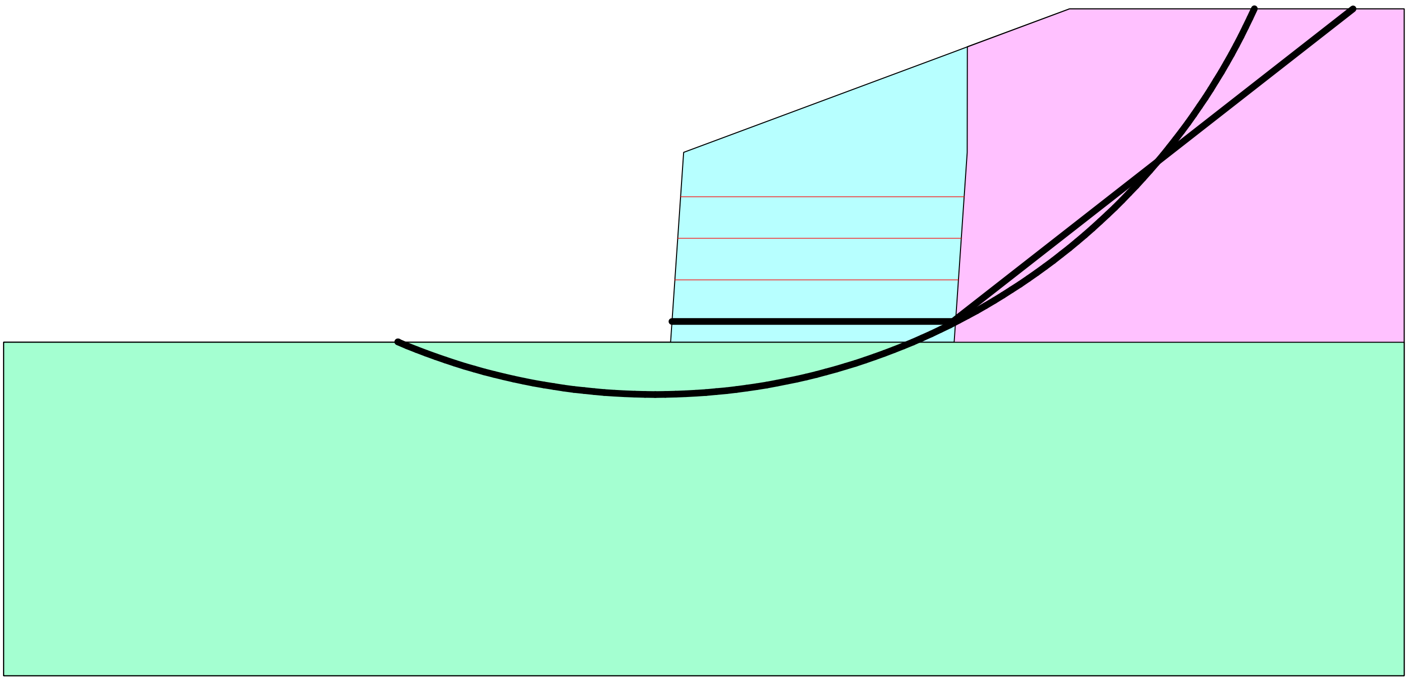
Minimum Factor of Safety = 1.31

Critical Two-Part Wedge: (Xa = 0.02, Ya = 0.22) [m]
(Xb = 2.99, Yb = 0.22) [m]
(Xc = 7.23, Yc = 3.53) [m]
(Number of slices used = 30)
Interslice resultant force inclination = 23.66 [degrees]

Three-Part Wedge Stability Analysis

N O T C O N D U C T E D

REINFORCEMENT LAYOUT: DRAWING



SCALE:

0 2 4 6[m]

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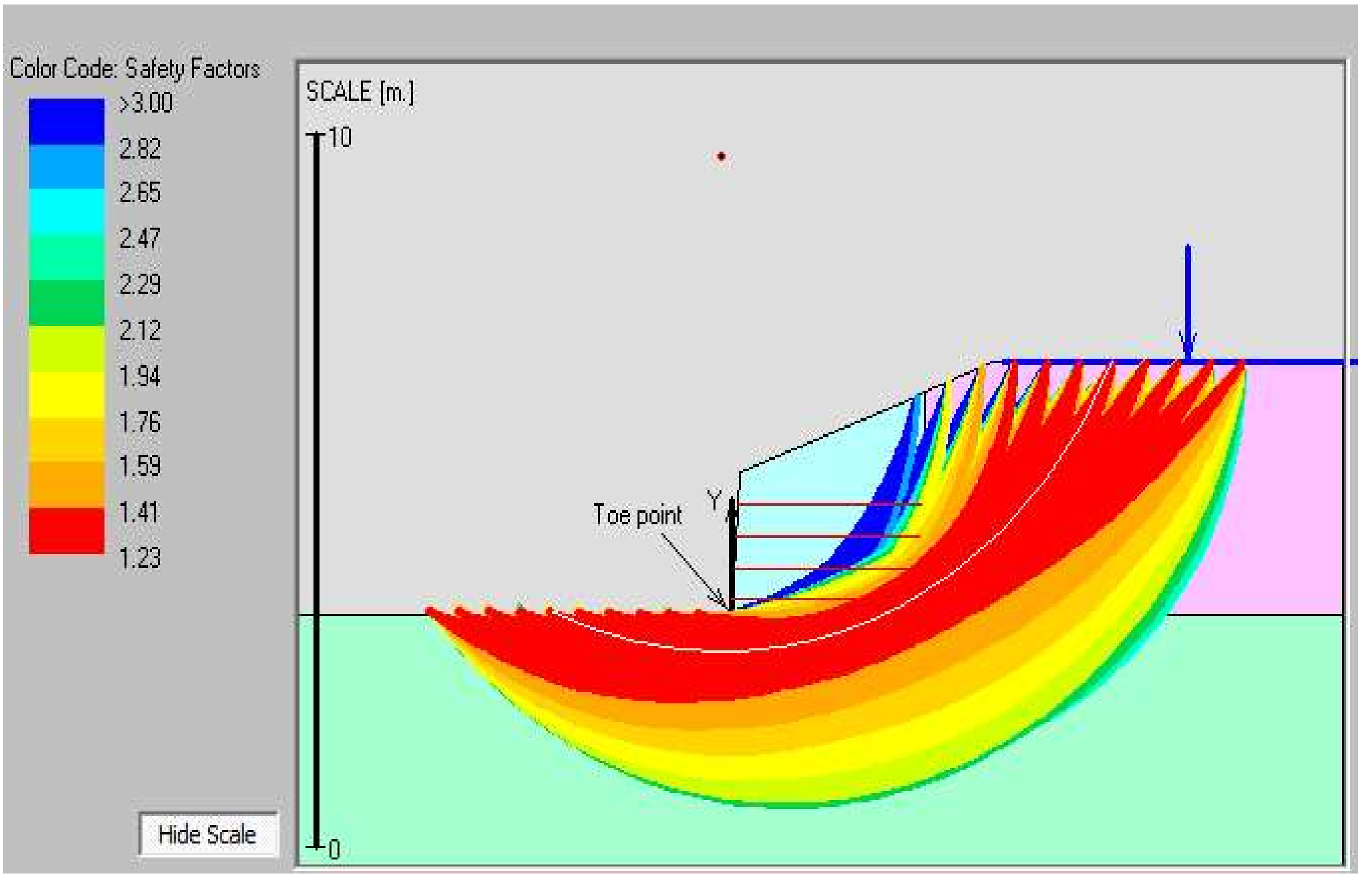
SAFETY MAP: BISHOP ROTATIONAL ANALYSIS MODE



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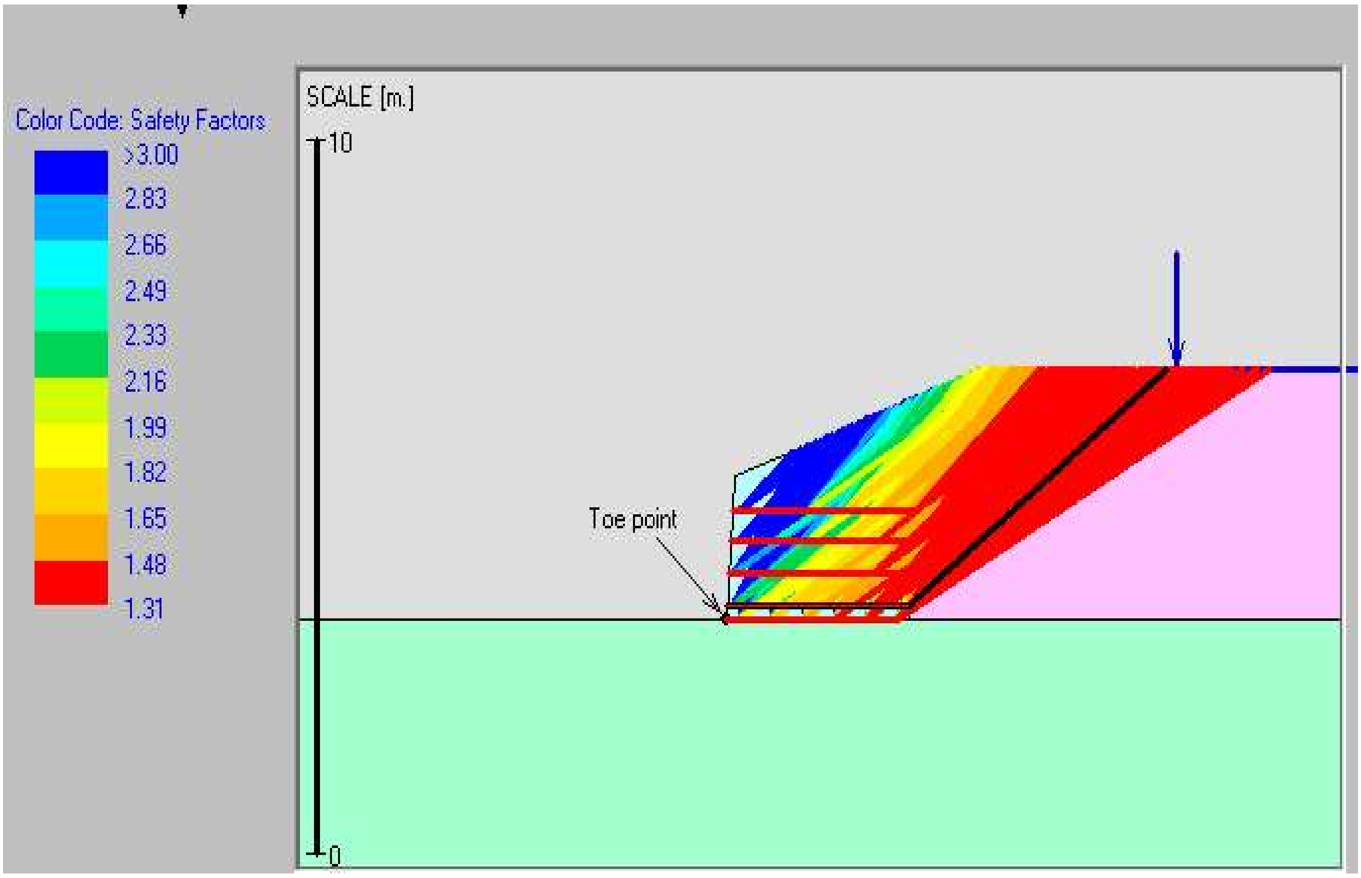
SAFETY MAP: SPENCER TRANSLATIONAL, 2-PART WEDGE



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AASHTO 2007 (LRFD)
km77+100（Combination A）

PROJECT IDENTIFICATION

Title: km77+100（Combination A）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+100（Combination A）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: DESIGN
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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DESIGN DATA

DESIGN OBJECTIVES

Minimum Capacity Demand Ratio in pullout, CDR-po	1.10
Minimum Capacity Demand Ratio in direct sliding, CDR-sliding	1.10
Maximum allowable eccentricity ratio at each reinforcement level, e/L	0.2500
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-static	1.30
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-seismic	1.10

Prescribed minimum resistive length to prevent pullout, Le = 1.00 m.
Prescribed minimum normalized length of each layer is: L/Hd = 0.70 --> L = 2.02 m.
Prescribed minimum absolute total length of each layer is: L = 3.00 m.

BEARING CAPACITY

Bearing capacity is controlled by general shear.

Maximum permissible eccentricity ratio (soil), e/L	0.2500
Min. Capacity Demand Ratio with respect to ultimate bearing capacity (Meyerhof approach)	1.10

Bearing capacity coefficients: Nc = 32.67 N γ= 25.99

SOIL DATA

REINFORCED SOIL

Unit weight, γ	19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ	33.0 °

RETAINED SOIL

Unit weight, γ	19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	31.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10°Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3713 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3541 Kae (Kh = 0) = 0.3369 Δ Kae = 0.0171 (see eq. 37 in DEMO 82)

DIRECT SLIDING / ECCENTRICITY

Seismic CDR is 100.0% of specified static CDR for direct sliding.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

BEARING CAPACITY

Seismic CDR is 100.0% of specified static CDR for bearing capacity.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

INTERNAL STABILITY

Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.
Seismic Capacity Demand Ratio in pullout, CDR-po, is 100.0% of its specified static value.
Seismic Capacity Demand Ratio, CDR-overall, is 100.0% of its specified static value.
The reduction of CDR pertains to geogrid strength and to connection strength for break mode of failure.

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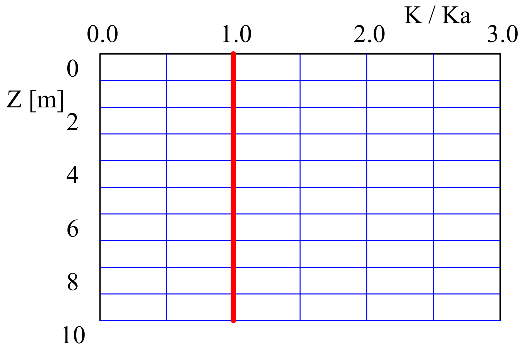
INPUT DATA: Geogrids
(Multiple type reinforcement)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	1.00	1.00			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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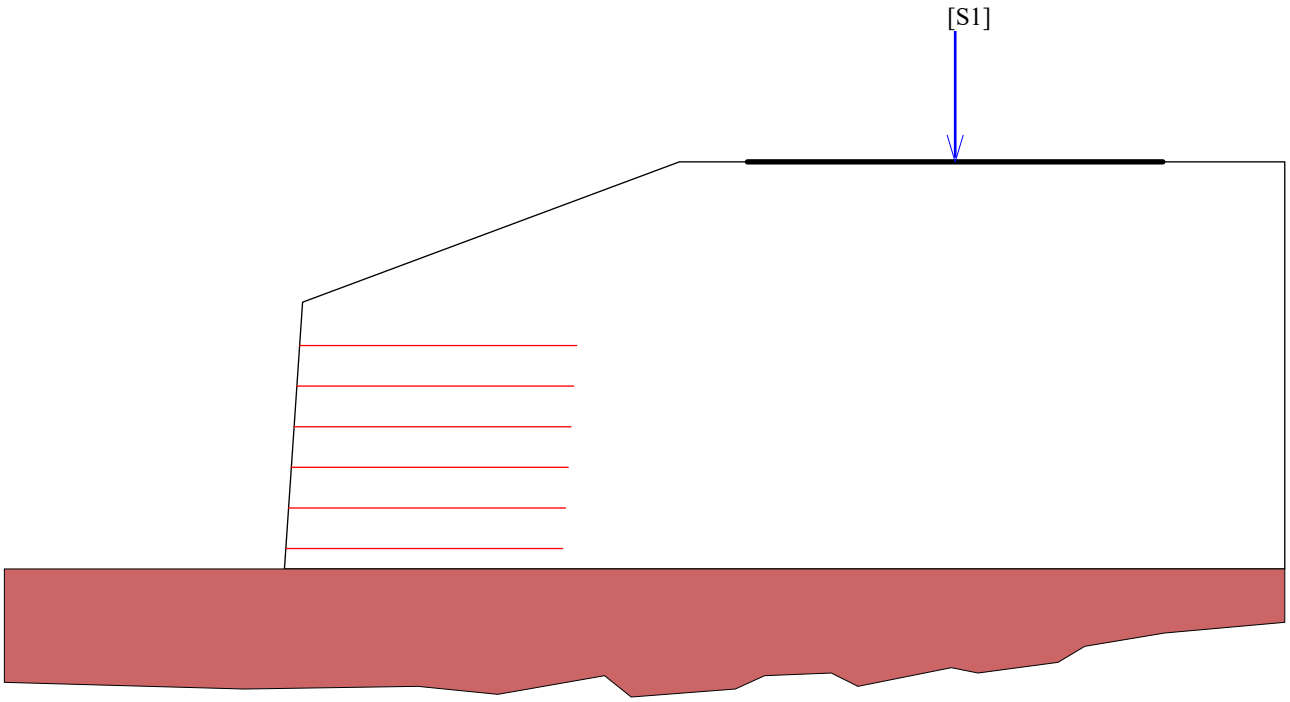
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	2.89	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 2.89 m }
Batter, ω	3.9	[deg]	
Backslope, β	20.4	[deg]	
Backslope rise	1.5	[m]	Broken back equivalent angle, I = 14.73° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 10.0 and Qv-l = 0.0 [kPa].
Footing width, b=4.5 [m]. Distance of center of footing from wall face, d = 7.1 [m] @ depth of 0.0 [m] below soil surface.

DESIGNED REINFORCEMENT LAYOUT:



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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.50		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.50		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.77		0.90

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.50	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.50	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.50

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	0.83		0.90
Reinforced Soil and Reinforcement	ϕ_τ	0.77		0.90

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
	ϕ_b	0.74		0.90

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REINFORCEMENT LAYOUT AND DESIGN CRITERIA

LEGEND: (1) Connection strength √ Satisfactory
(2) Geogrid strength ⊗ Unsatisfactory
(3) Pullout resistance
(4) Direct sliding
(5) Eccentricity

Bearing capacity: √
Foudation Interface: Direct sliding √ Eccentricity √

#	Geogrid Elevation [m]	Length [m]	Type #	(1)	(2)	(3)	(4)	(5)
1	0.22	3.00	1	N/A	√	√	√	√
2	0.66	3.00	1	N/A	√	√	√	√
3	1.10	3.00	1	N/A	√	√	√	√
4	1.54	3.00	1	N/A	√	√	√	√
5	1.98	3.00	1	N/A	√	√	√	√
6	2.42	3.00	1	N/A	√	√	√	√

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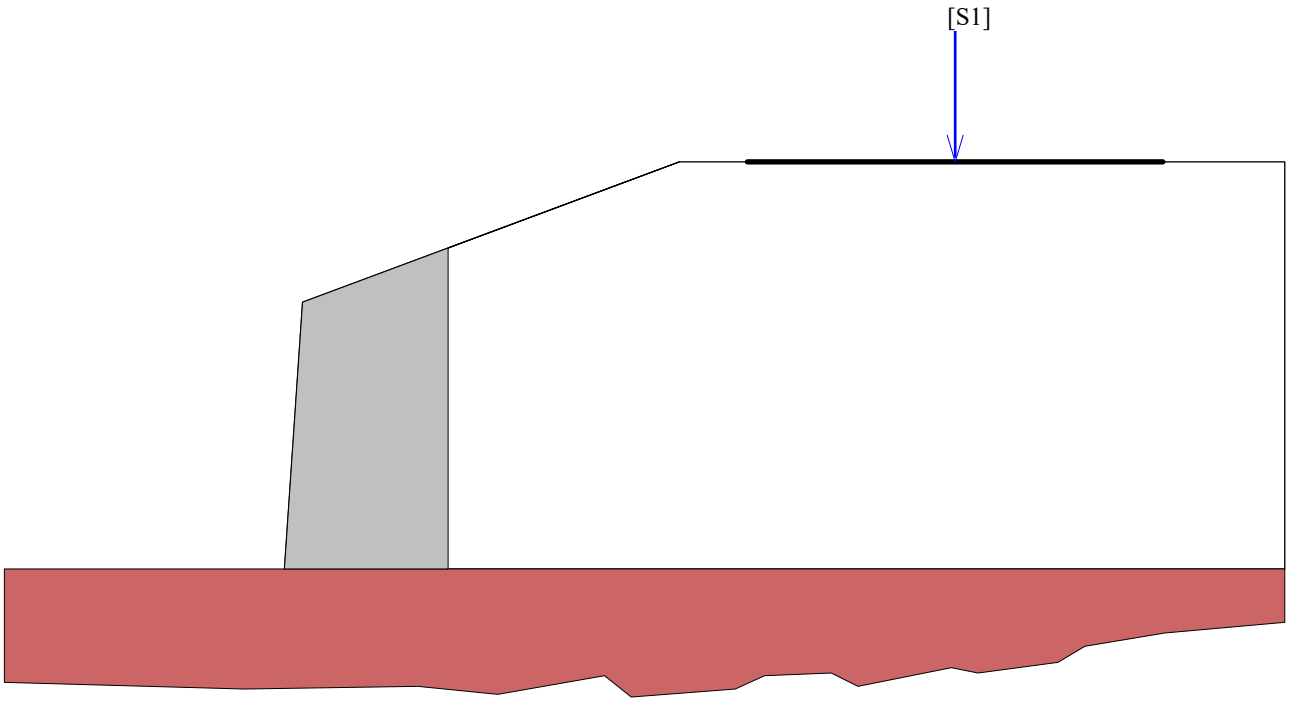
BEARING CAPACITY for DESIGNED LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	218.1	225.6	[kPa]
Meyerhof stress, σ_V	140.17	110.3	[kPa]
Eccentricity, e	0.27	0.37	[m]
Eccentricity, e/L	0.154	0.206	
CDR calculated	1.56	2.05	
Base length	1.77	1.77	[m]



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DIRECT SLIDING for DESIGNED LAYOUT (for GEOGRID reinforcements)

Specified CDR-static = 1.100 and CDR-seismic = 1.100

Along reinforced and foundation soils interface: CDR-static = 1.350 and CDR-seismic = 1.333

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	3.00	1.524	1.654	1	---RW-95
2	0.66	3.00	1.692	1.855	1	---RW-95
3	1.10	3.00	1.883	2.083	1	---RW-95
4	1.54	3.00	2.117	2.368	1	---RW-95
5	1.98	3.00	2.402	2.726	1	---RW-95
6	2.42	3.00	2.731	3.151	1	---RW-95

ECCENTRICITY for DESIGNED LAYOUT

At interface with foundation: e/L static = 0.1544, e/L seismic = 0.1889; Overturning: CDR-static = 2.43, CDR-seismic = 2.12

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	3.00	0.0308	0.0407	1	---RW-95
2	0.66	3.00	0.0112	0.0181	1	---RW-95
3	1.10	3.00	-0.0079	-0.0035	1	---RW-95
4	1.54	3.00	-0.0276	-0.0252	1	---RW-95
5	1.98	3.00	-0.0505	-0.0494	1	---RW-95
6	2.42	3.00	-0.0834	-0.0831	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	11.6	0.7	1.000	2.619	1.000	2.552	---RW-95
2	0.66	30.3	9.9	0.6	1.000	3.061	1.000	2.977	---RW-95
3	1.10	30.3	8.2	0.6	1.000	3.682	1.000	3.570	---RW-95
4	1.54	30.3	6.6	0.5	1.000	4.621	1.000	4.460	---RW-95
5	1.98	30.3	4.9	0.5	1.000	6.201	1.000	5.940	---RW-95
6	2.42	30.3	4.3	0.4	1.000	7.050	1.000	6.748	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	11.56	0.67	2.90	0.10	95.6	1.100	8.273	89.4	1.100	7.311
2	0.66	1.000	9.89	0.62	2.69	0.31	78.0	1.100	7.885	72.9	1.100	6.936
3	1.10	1.000	8.22	0.58	2.48	0.52	61.9	1.100	7.527	57.9	1.100	6.578
4	1.54	1.000	6.55	0.53	2.27	0.73	47.5	1.100	7.245	44.4	1.100	6.270
5	1.98	1.000	4.88	0.48	2.06	0.94	34.7	1.100	7.112	32.5	1.100	6.057
6	2.42	1.000	4.29	0.43	1.85	1.15	23.7	1.100	5.518	22.2	1.100	4.690

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AASHTO 2007 (LRFD)
km77+100（Combination B）

PROJECT IDENTIFICATION

Title: km77+100（Combination B）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

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PROGRAM MODE: DESIGN
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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DESIGN DATA

DESIGN OBJECTIVES

Minimum Capacity Demand Ratio in pullout, CDR-po	1.10
Minimum Capacity Demand Ratio in direct sliding, CDR-sliding	1.10
Maximum allowable eccentricity ratio at each reinforcement level, e/L	0.2500
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-static	1.30
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-seismic	1.10

Prescribed minimum resistive length to prevent pullout, Le = 1.00 m.
Prescribed minimum normalized length of each layer is: L/Hd = 0.70 --> L = 2.02 m.
Prescribed minimum absolute total length of each layer is: L = 3.00 m.

BEARING CAPACITY

Bearing capacity is controlled by general shear.

Maximum permissible eccentricity ratio (soil), e/L	0.2500
Min. Capacity Demand Ratio with respect to ultimate bearing capacity (Meyerhof approach)	1.10

Bearing capacity coefficients: Nc = 32.67 N γ= 25.99

SOIL DATA

REINFORCED SOIL

Unit weight, γ	19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ	33.0 °

RETAINED SOIL

Unit weight, γ	19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	31.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3713 (if batter is less than 10°Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3541 Kae (Kh = 0) = 0.3369 Δ Kae = 0.0171 (see eq. 37 in DEMO 82)

DIRECT SLIDING / ECCENTRICITY

Seismic CDR is 100.0% of specified static CDR for direct sliding.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

BEARING CAPACITY

Seismic CDR is 100.0% of specified static CDR for bearing capacity.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

INTERNAL STABILITY

Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.
Seismic Capacity Demand Ratio in pullout, CDR-po, is 100.0% of its specified static value.
Seismic Capacity Demand Ratio, CDR-overall, is 100.0% of its specified static value.
The reduction of CDR pertains to geogrid strength and to connection strength for break mode of failure.

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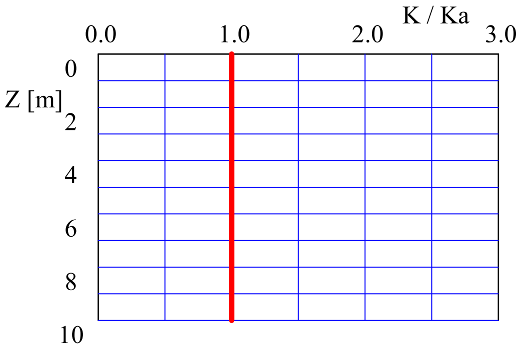
INPUT DATA: Geogrids
(Multiple type reinforcement)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	1.00	1.00			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tan ϕ	0.67tan ϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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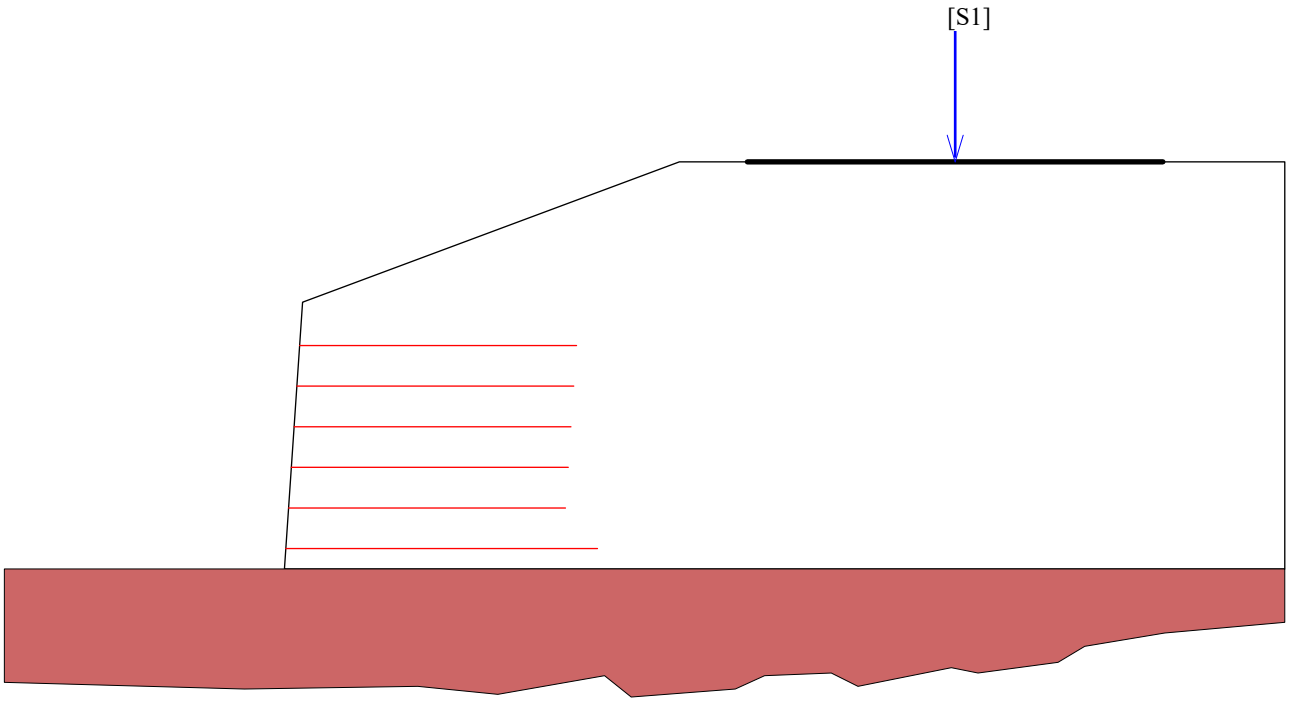
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	2.89	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 2.89 m }
Batter, ω	3.9	[deg]	
Backslope, β	20.4	[deg]	
Backslope rise	1.5	[m]	Broken back equivalent angle, I = 14.73° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 10.0 and Qv-l = 0.0 [kPa].
Footing width, b=4.5 [m]. Distance of center of footing from wall face, d = 7.1 [m] @ depth of 0.0 [m] below soil surface.

DESIGNED REINFORCEMENT LAYOUT:



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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.00	
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00	
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.00	
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.00	
Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	0.90
Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	0.90
Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.77	0.90

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:

		Static		Combined Static/Seismic
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:

		Static	Combined Static/Seismic
Reinforced Soil and Foundation	ϕ_τ	0.83	0.90
Reinforced Soil and Reinforcement	ϕ_τ	0.77	0.90

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:

	Static	Combined Static/Seismic
ϕ_b	0.74	0.90

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REINFORCEMENT LAYOUT AND DESIGN CRITERIA

LEGEND: (1) Connection strength √ Satisfactory
(2) Geogrid strength ⊗ Unsatisfactory
(3) Pullout resistance
(4) Direct sliding
(5) Eccentricity

Bearing capacity: √
Foudation Interface: Direct sliding √ Eccentricity √

#	Geogrid Elevation [m]	Geogrid Length [m]	Type #	(1)	(2)	(3)	(4)	(5)
1	0.22	3.38	1	N/A	√	√	√	√
2	0.66	3.00	1	N/A	√	√	√	√
3	1.10	3.00	1	N/A	√	√	√	√

#	Geogrid Elevation [m]	Geogrid Length [m]	Type #	(1)	(2)	(3)	(4)	(5)
4	1.54	3.00	1	N/A	√	√	√	√
5	1.98	3.00	1	N/A	√	√	√	√
6	2.42	3.00	1	N/A	√	√	√	√

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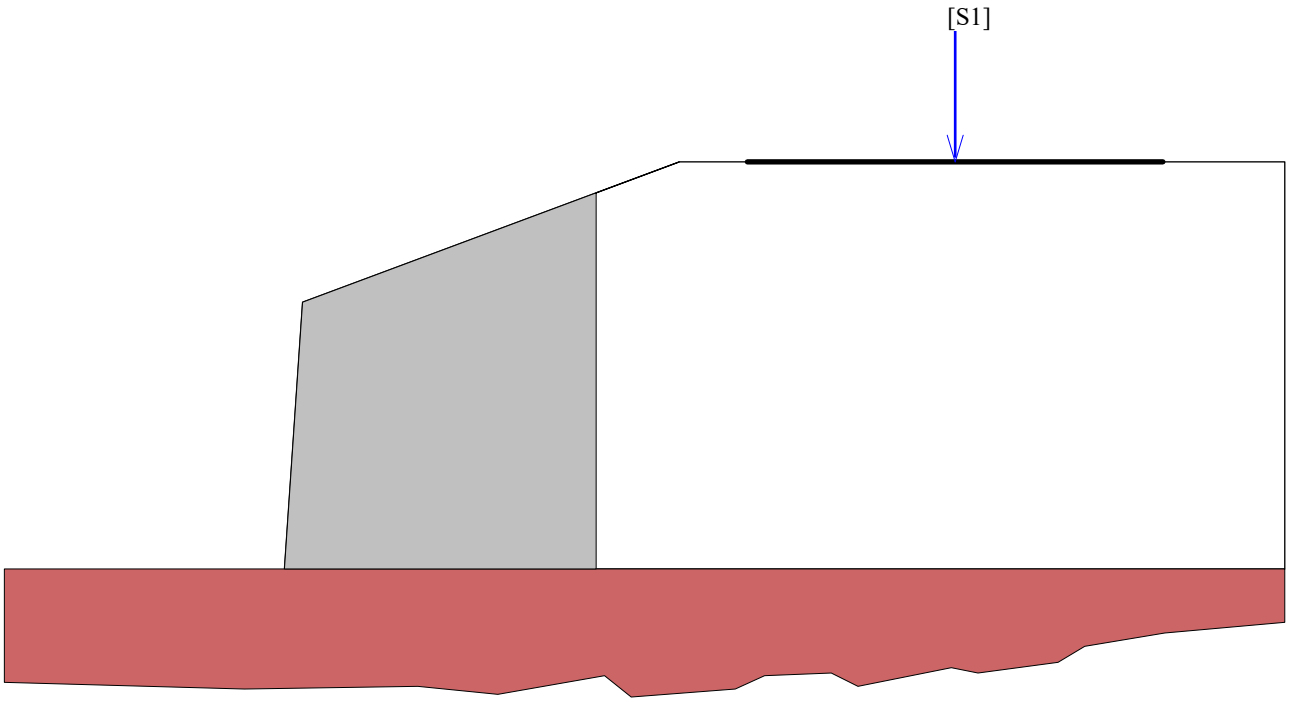
BEARING CAPACITY for DESIGNED LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	531.2	682.2	[kPa]
Meyerhof stress, σ_V	82.07	75.4	[kPa]
Eccentricity, e	0.20	0.11	[m]
Eccentricity, e/L	0.058	0.033	
CDR calculated	6.47	9.05	
Base length	3.38	3.38	[m]



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Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0

Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0

DIRECT SLIDING for DESIGNED LAYOUT
(for GEOGRID reinforcements)

Specified CDR-static = 1.100 and CDR-seismic = 1.100

Along reinforced and foundation soils interface: CDR-static = 1.366 and CDR-seismic = 2.031

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	3.38	1.101	1.772	1	---RW-95
2	0.66	3.00	1.162	1.894	1	---RW-95
3	1.10	3.00	1.289	2.121	1	---RW-95
4	1.54	3.00	1.445	2.403	1	---RW-95
5	1.98	3.00	1.635	2.753	1	---RW-95
6	2.42	3.00	1.854	3.165	1	---RW-95

ECCENTRICITY for DESIGNED LAYOUT

At interface with foundation: e/L static = 0.0580, e/L seismic = 0.0329; Overturning: CDR-static = 4.05, CDR-seismic = 5.39

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	3.38	0.0455	0.0229	1	---RW-95
2	0.66	3.00	0.0368	0.0158	1	---RW-95
3	1.10	3.00	0.0109	-0.0050	1	---RW-95
4	1.54	3.00	-0.0147	-0.0260	1	---RW-95
5	1.98	3.00	-0.0423	-0.0498	1	---RW-95
6	2.42	3.00	-0.0789	-0.0832	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	7.7	0.7	1.000	3.928	1.000	3.766	---RW-95
2	0.66	30.3	6.6	0.6	1.000	4.591	1.000	4.409	---RW-95
3	1.10	30.3	5.5	0.6	1.000	5.523	1.000	5.281	---RW-95
4	1.54	30.3	4.4	0.5	1.000	6.931	1.000	6.584	---RW-95
5	1.98	30.3	3.3	0.5	1.000	9.301	1.000	8.740	---RW-95
6	2.42	30.3	2.9	0.4	1.000	10.576	1.000	9.925	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	7.71	0.74	3.27	0.10	111.5	1.100	14.472	104.3	1.100	12.346
2	0.66	1.000	6.59	0.61	2.69	0.31	78.0	1.100	11.828	72.9	1.100	10.126
3	1.10	1.000	5.48	0.56	2.48	0.52	61.9	1.100	11.290	57.9	1.100	9.578
4	1.54	1.000	4.37	0.51	2.27	0.73	47.5	1.100	10.867	44.4	1.100	9.093
5	1.98	1.000	3.25	0.47	2.06	0.94	34.7	1.100	10.668	32.5	1.100	8.726
6	2.42	1.000	2.86	0.42	1.85	1.15	23.7	1.100	8.277	22.2	1.100	6.752

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AASHTO 2007 (LRFD)
km77+100（Combination C）

PROJECT IDENTIFICATION

Title: km77+100（Combination C）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+100（Combination C）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: DESIGN
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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DESIGN DATA

DESIGN OBJECTIVES

Minimum Capacity Demand Ratio in pullout, CDR-po	1.10
Minimum Capacity Demand Ratio in direct sliding, CDR-sliding	1.10
Maximum allowable eccentricity ratio at each reinforcement level, e/L	0.2500
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-static	1.30
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-seismic	1.10

Prescribed minimum resistive length to prevent pullout, Le = 1.00 m.
Prescribed minimum normalized length of each layer is: L/Hd = 0.70 --> L = 2.02 m.
Prescribed minimum absolute total length of each layer is: L = 3.00 m.

BEARING CAPACITY

Bearing capacity is controlled by general shear.

Maximum permissible eccentricity ratio (soil), e/L	0.2500
Min. Capacity Demand Ratio with respect to ultimate bearing capacity (Meyerhof approach)	1.10

Bearing capacity coefficients: Nc = 32.67 N γ= 25.99

SOIL DATA

REINFORCED SOIL

Unit weight, γ	19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ	33.0 °

RETAINED SOIL

Unit weight, γ	19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	31.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3713 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3541 Kae (Kh = 0) = 0.3369 Δ Kae = 0.0171 (see eq. 37 in DEMO 82)

DIRECT SLIDING / ECCENTRICITY

Seismic CDR is 100.0% of specified static CDR for direct sliding.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

BEARING CAPACITY

Seismic CDR is 100.0% of specified static CDR for bearing capacity.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

INTERNAL STABILITY

Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.
Seismic Capacity Demand Ratio in pullout, CDR-po, is 100.0% of its specified static value.
Seismic Capacity Demand Ratio, CDR-overall, is 100.0% of its specified static value.
The reduction of CDR pertains to geogrid strength and to connection strength for break mode of failure.

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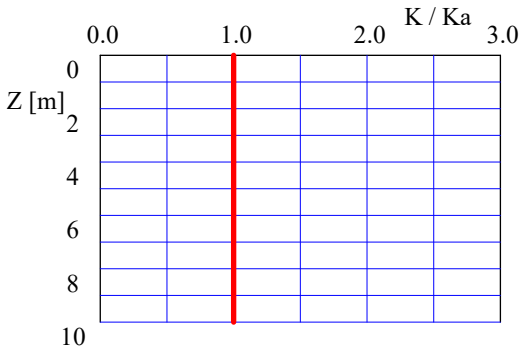
INPUT DATA: Geogrids
(Multiple type reinforcement)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	1.00	1.00			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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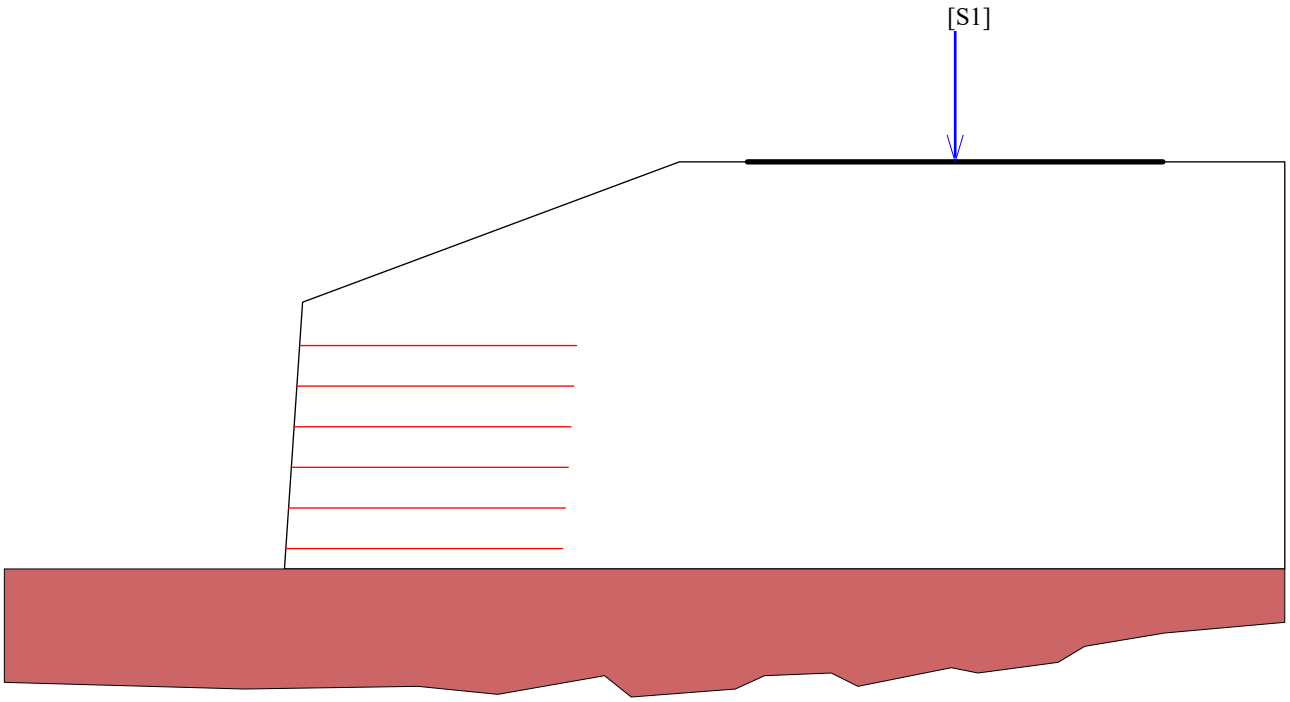
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	2.89	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 2.89 m }
Batter, ω	3.9	[deg]	
Backslope, β	20.4	[deg]	
Backslope rise	1.5	[m]	Broken back equivalent angle, I = 14.73° (see Fig. 25 in DEMO 82)

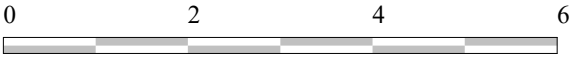
U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 10.0 and Qv-l = 0.0 [kPa].
Footing width, b=4.5 [m]. Distance of center of footing from wall face, d = 7.1 [m] @ depth of 0.0 [m] below soil surface.

DESIGNED REINFORCEMENT LAYOUT:



SCALE:



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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.00
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.00

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	1.00

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	1.00	1.00

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.00
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic
Reinforced Soil and Foundation	ϕ_τ	1.00	1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00	1.00

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:	Static	Combined Static/Seismic
ϕ_b	1.00	1.00

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REINFORCEMENT LAYOUT AND DESIGN CRITERIA

LEGEND: (1) Connection strength √ Satisfactory
(2) Geogrid strength ⊗ Unsatisfactory
(3) Pullout resistance
(4) Direct sliding
(5) Eccentricity

Bearing capacity: √
Foudation Interface: Direct sliding √ Eccentricity √

#	Geogrid Elevation [m]	Geogrid Length [m]	Type #	(1)	(2)	(3)	(4)	(5)
1	0.22	3.00	1	N/A	√	√	√	√
2	0.66	3.00	1	N/A	√	√	√	√
3	1.10	3.00	1	N/A	√	√	√	√

#	Geogrid Elevation [m]	Geogrid Length [m]	Type #	(1)	(2)	(3)	(4)	(5)
4	1.54	3.00	1	N/A	√	√	√	√
5	1.98	3.00	1	N/A	√	√	√	√
6	2.42	3.00	1	N/A	√	√	√	√

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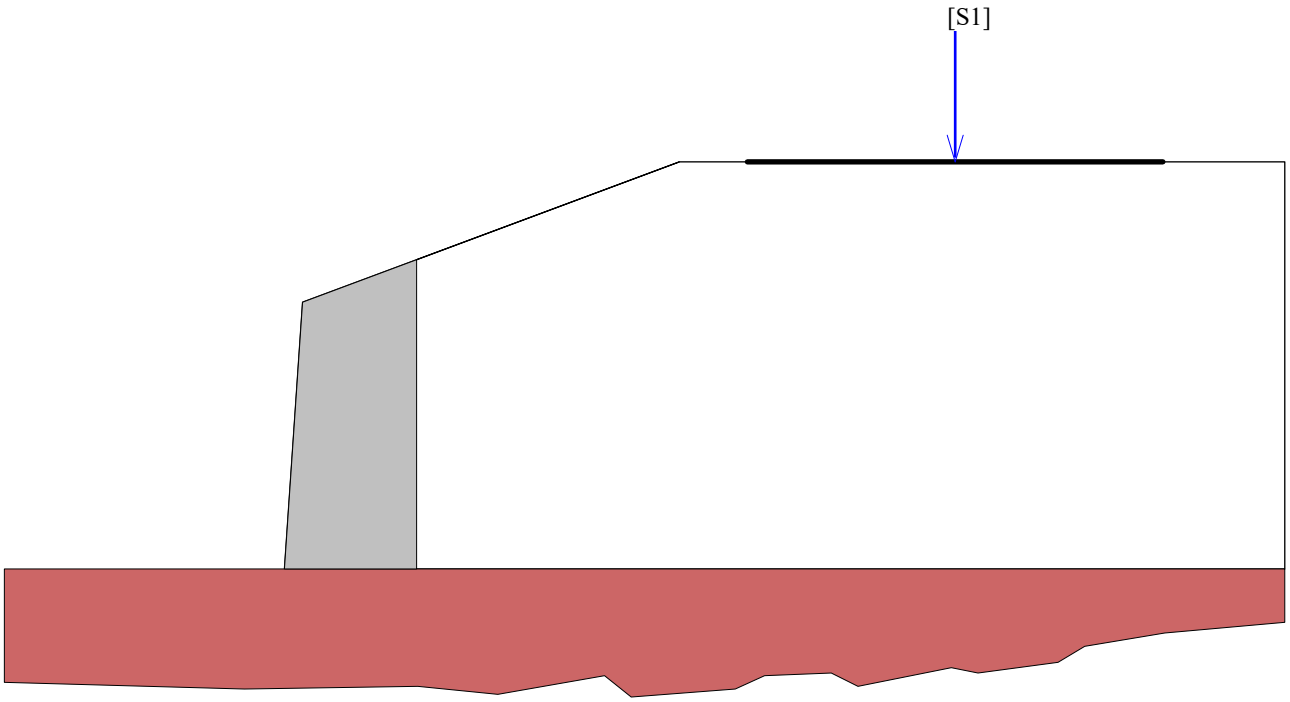
BEARING CAPACITY for DESIGNED LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	179.7	155.6	[kPa]
Meyerhof stress, σ_V	121.80	141.0	[kPa]
Eccentricity, e	0.34	0.39	[m]
Eccentricity, e/L	0.239	0.274	
CDR calculated	1.48	1.10	
Base length	1.43	1.43	[m]



SCALE:

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DIRECT SLIDING for DESIGNED LAYOUT (for GEOGRID reinforcements)

Specified CDR-static = 1.100 and CDR-seismic = 1.100

Along reinforced and foundation soils interface: CDR-static = 1.392 and CDR-seismic = 1.301

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	3.00	1.979	1.887	1	---RW-95
2	0.66	3.00	2.197	2.104	1	---RW-95
3	1.10	3.00	2.445	2.356	1	---RW-95
4	1.54	3.00	2.749	2.670	1	---RW-95
5	1.98	3.00	3.120	3.059	1	---RW-95
6	2.42	3.00	3.547	3.517	1	---RW-95

ECCENTRICITY for DESIGNED LAYOUT

At interface with foundation: e/L static = 0.2391, e/L seismic = 0.2744; Overturning: CDR-static = 1.78, CDR-seismic = 1.60

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	3.00	0.0308	0.0375	1	---RW-95
2	0.66	3.00	0.0112	0.0158	1	---RW-95
3	1.10	3.00	-0.0079	-0.0050	1	---RW-95
4	1.54	3.00	-0.0276	-0.0260	1	---RW-95
5	1.98	3.00	-0.0505	-0.0498	1	---RW-95
6	2.42	3.00	-0.0834	-0.0832	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	7.7	0.7	1.000	3.928	1.000	4.200	---RW-95
2	0.66	30.3	6.6	0.6	1.000	4.591	1.000	4.894	---RW-95
3	1.10	30.3	5.5	0.6	1.000	5.523	1.000	5.861	---RW-95
4	1.54	30.3	4.4	0.5	1.000	6.931	1.000	7.306	---RW-95
5	1.98	30.3	3.3	0.5	1.000	9.301	1.000	9.696	---RW-95
6	2.42	30.3	2.9	0.4	1.000	10.576	1.000	11.009	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	7.71	0.67	2.90	0.10	124.2	1.100	16.117	99.4	1.100	11.859
2	0.66	1.000	6.59	0.62	2.69	0.31	101.3	1.100	15.361	81.0	1.100	11.226
3	1.10	1.000	5.48	0.58	2.48	0.52	80.4	1.100	14.663	64.3	1.100	10.616
4	1.54	1.000	4.37	0.53	2.27	0.73	61.6	1.100	14.113	49.3	1.100	10.075
5	1.98	1.000	3.25	0.48	2.06	0.94	45.1	1.100	13.855	36.1	1.100	9.664
6	2.42	1.000	2.86	0.43	1.85	1.15	30.8	1.100	10.750	24.6	1.100	7.477

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Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0

77+100 overall stability(no seismicity)

Report created by ReSSA(3.0): Update #4.21: Copyright (c) 2001-2016, ADAMA Engineering, Inc.

PROJECT IDENTIFICATION

Title:	77+100 overall stability(no seismicity)
Project Number:	-
Client:	
Designer:	戴征杰（BOSTD）

Description:

Company's information:

Name:	China Railway Design Corporation Serbia Ogranak Beogrda
Street:	Koste Racina 16b, 11000 Belgrade, Serbia ,
Telephone #:	
Fax #:	
E-Mail:	

Original file path and name:
Original date and time of creating this file: Mon Apr 12 11:25:38 2021

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0

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INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [kN/m^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [kPa]
.1....... Reinforced Soil..................................	19.5	33.0	0.0
.2...	20.0	28.0	0.0
.3...	20.0	28.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [kN/m]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Additional Reduction Factor, RFa	Coverage Ratio, Rc
1	---RW-95	95.70	1.16	1.10	2.23	1.00	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
1	---RW-95	0.77	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Not Applicable

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DRAWING OF SPECIFIED GEOMETRY - GENERAL - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

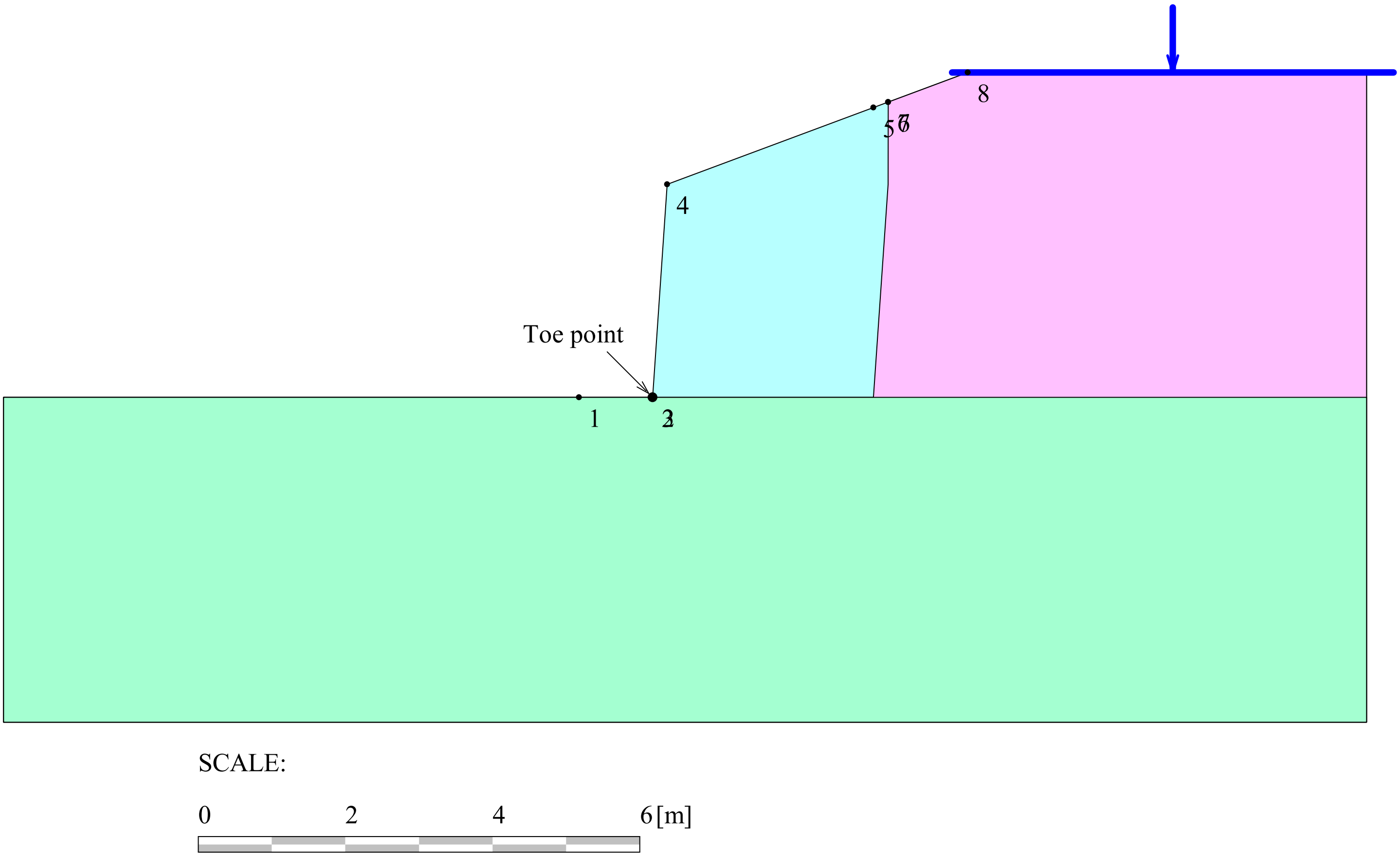
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Surcharge load, Q1 ....None
Surcharge load, Q2 ....None
Surcharge load, Q3 ....None

STRIP LOAD

Strip Load #1.. 10.00 [kPa] Width of base, b = 6.00 [m] Distance from toe point, d = 7.07 [m]



Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0

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Version 3.0 ReSSA Version 3.0

TABULATED DETAILS OF GEMERAL SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

	#	Xi	Yi
Top of Layer 1	1	-1.00	0.00
	2	-0.00	0.00
	3	0.00	0.00
	4	0.20	2.89
	5	4.28	4.41
Top of Layer 2	6	-1.00	0.00
	7	-0.00	0.00
	8	0.00	0.00
	9	3.00	0.00
	10	3.20	2.89
	11	3.20	4.01
	12	4.28	4.41
Top of Layer 3	13	-1.00	0.00
	14	-0.00	0.00
	15	0.00	0.00

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TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

#	X	Y1	Y2	Y3
1	-1.00	0.00	0.00	0.00
2	-0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.20	2.89	0.00	0.00
5	3.00	3.93	0.00	0.00
6	3.20	4.01	2.89	0.00
7	3.20	4.01	4.01	0.00
8	4.28	4.41	4.41	0.00

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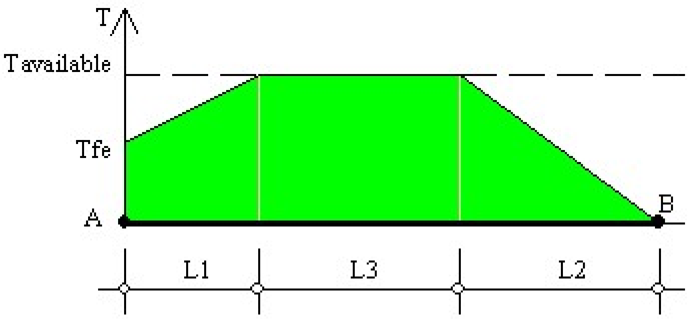
Version 3.0 ReSSA Version 3.0

DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER



A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [m]	L [m]	L1 [m]	L2 [m]	L3 [m]	Tfe [kN/m]	Tavailable [kN/m]
1	---RW-95	0.22	4.00	0.00	1.12	2.88	33.63	33.63
2	---RW-95	0.66	3.50	0.00	1.23	2.27	33.63	33.63
3	---RW-95	1.10	3.00	0.00	1.44	1.56	33.63	33.63
4	---RW-95	1.54	3.00	0.00	1.77	1.23	33.63	33.63
5	---RW-95	1.98	3.00	0.00	2.39	0.61	33.63	33.63
6	---RW-95	2.42	3.00	0.00	3.00	0.00	27.45	27.45 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength.

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RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [m]		Exit Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	5.40	4.41	-3.24	0.01	-0.08	4.49	5.48	1.48	
2	6.13	4.41	-3.30	0.05	0.04	5.21	6.15	1.41	
3	6.86	4.41	-3.77	0.05	-0.03	6.08	7.09	1.37	
. 4	7.59	4.41	-3.72	0.02	-0.07	7.39	8.23	1.37 .	OK
5	8.32	4.41	-4.16	0.01	-0.32	9.01	9.78	1.39	
6	9.05	4.41	-4.24	0.04	-0.32	10.50	11.17	1.44	
7	9.78	4.41	-4.18	0.01	-0.38	12.30	12.86	1.49	
8	10.51	4.41	-4.60	0.00	-0.68	14.65	15.16	1.58	
9	11.24	4.41	-4.70	0.02	-0.73	16.76	17.20	1.68	
10	11.97	4.41	-4.63	0.01	-0.66	18.53	18.95	1.78	
11	12.70	4.41	-4.75	0.03	-0.83	21.36	21.69	1.89	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points).

Exit Point #	Exit Point (X, Y) [m]		Entry Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	-4.72	0.06	7.59	4.41	-0.50	7.71	8.74	1.38	
2	-4.22	0.04	7.59	4.41	-0.29	7.56	8.49	1.37	
. 3	-3.72	0.02	7.59	4.41	-0.07	7.39	8.23	1.37 .	OK
4	-3.32	0.05	7.59	4.41	0.14	7.21	7.96	1.37	
5	-2.83	0.04	6.86	4.41	0.43	5.75	6.57	1.38	
6	-2.40	0.05	6.86	4.41	0.66	5.57	6.31	1.40	
7	-1.93	0.04	7.59	4.41	0.82	6.59	7.11	1.43	
8	-1.46	0.03	7.59	4.41	1.06	6.36	6.81	1.47	
9	-0.97	0.02	7.59	4.41	1.23	6.26	6.62	1.53	
10	-0.49	0.01	7.59	4.41	1.49	6.00	6.31	1.60	
11	-0.00	0.00	8.32	4.41	1.62	7.00	7.19	1.67	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

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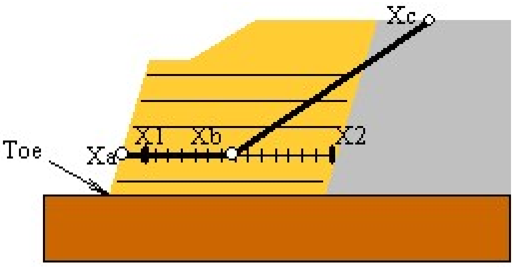
RESULTS OF TRANSLATIONAL ANALYSIS



Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [m]	(Xa, Ya) [m]		(Xb, Yb) [m]		(Xc, Yc) [m]		Fs	STATUS
At toe elevation	0.00	0.00	0.00	3.08	0.00	8.72	4.41	1.61	OK
Reinf. Layer #1	0.22	0.02	0.22	3.99	0.22	8.81	4.41	1.62	Minimum on Edge
Reinf. Layer #2	0.66	0.05	0.66	3.49	0.66	7.80	4.41	1.57	Minimum on Edge
. Reinf. Layer #3	1.10	0.08	1.10	3.09	1.10	7.03	4.41	1.54	Minimum on Edge
Reinf. Layer #4	1.54	0.11	1.54	3.09	1.54	6.63	4.41	1.59	Minimum on Edge
Reinf. Layer #5	1.98	0.14	1.98	3.09	1.98	6.20	4.41	1.64	Minimum on Edge
Reinf. Layer #6	2.42	0.17	2.42	3.19	2.42	5.74	4.41	1.65	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

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CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.37

Critical Circle: Xc = -0.07[m], Yc = 7.39[m], R = 8.23[m]. (Number of slices used = 57)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

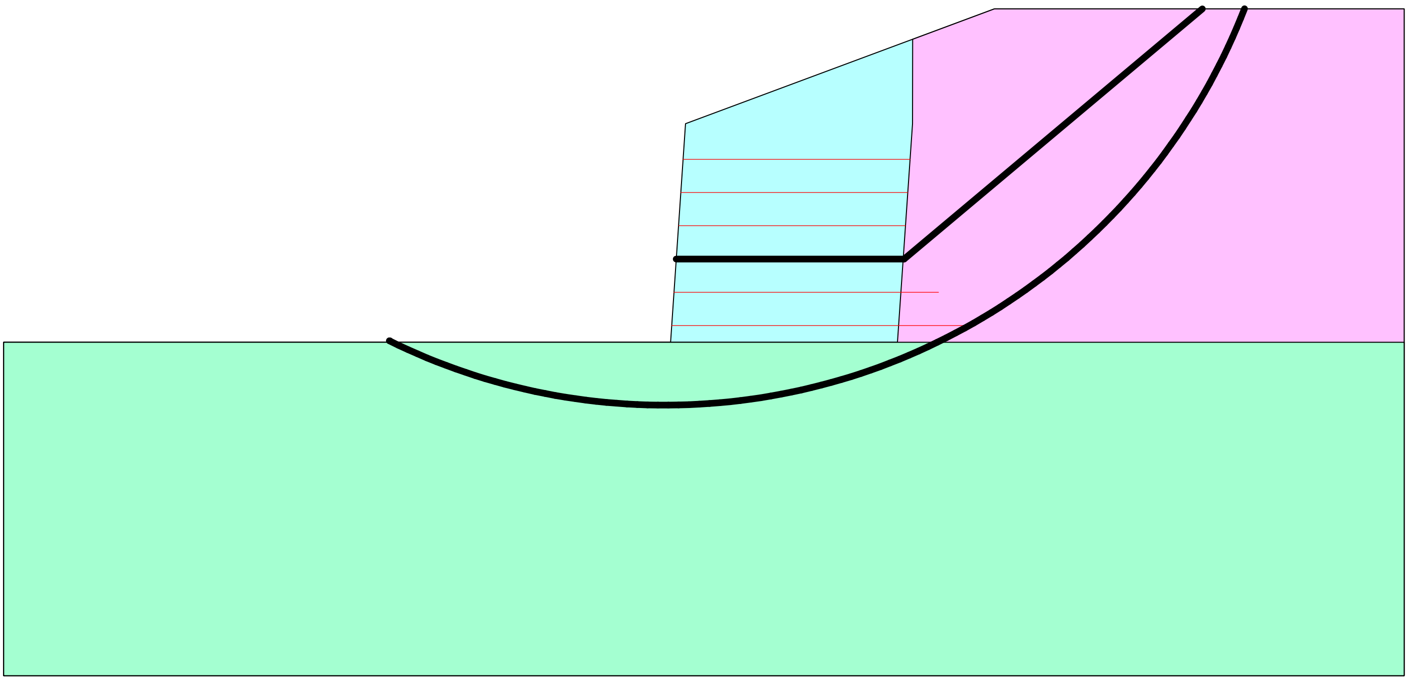
Minimum Factor of Safety = 1.54

Critical Two-Part Wedge: (Xa = 0.08, Ya = 1.10) [m]
(Xb = 3.09, Yb = 1.10) [m]
(Xc = 7.03, Yc = 4.41) [m]
(Number of slices used = 30)
Interslice resultant force inclination = 24.30 [degrees]

Three-Part Wedge Stability Analysis

N O T C O N D U C T E D

REINFORCEMENT LAYOUT: DRAWING



SCALE:

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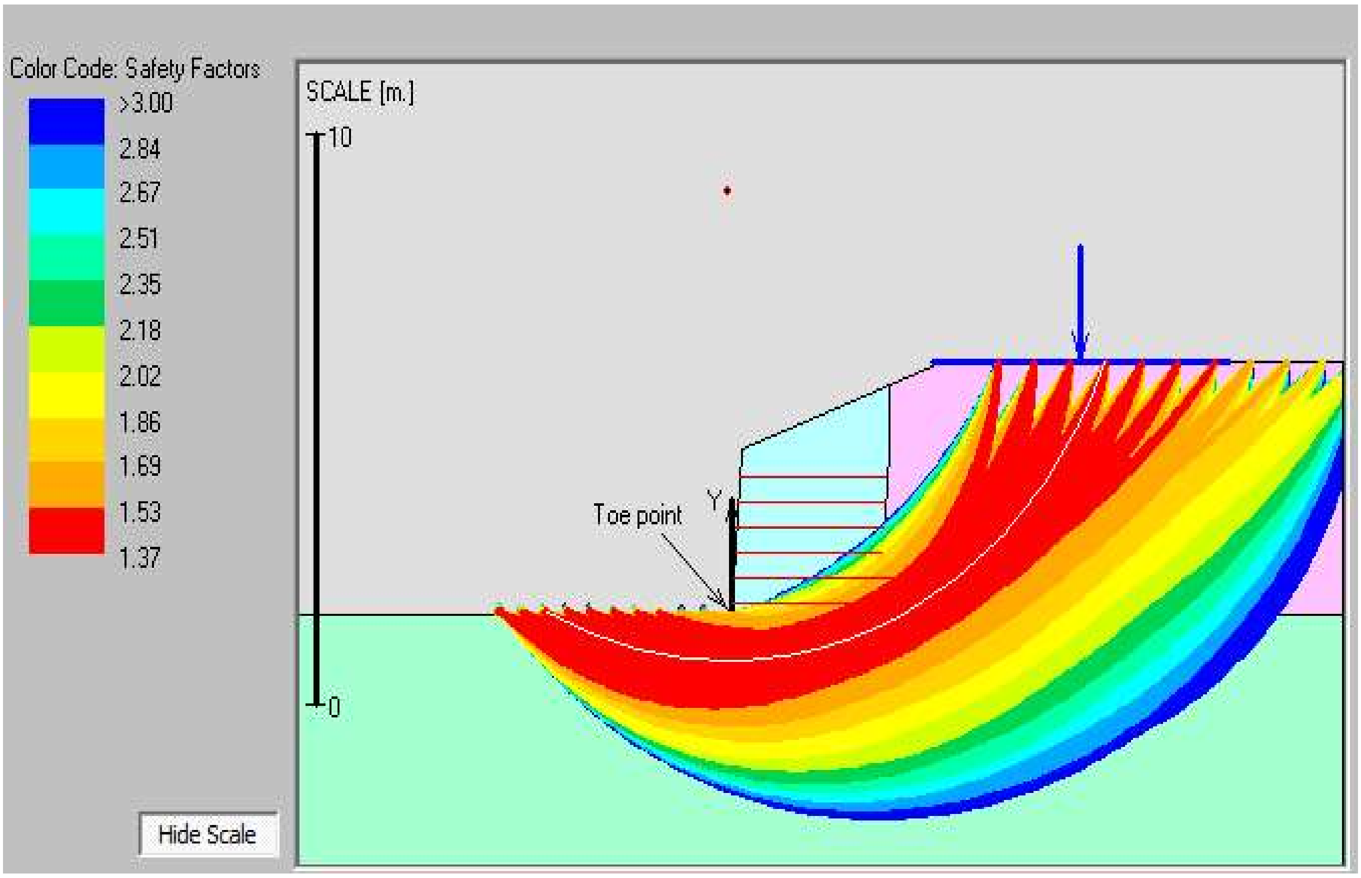
SAFETY MAP: BISHOP ROTATIONAL ANALYSIS MODE



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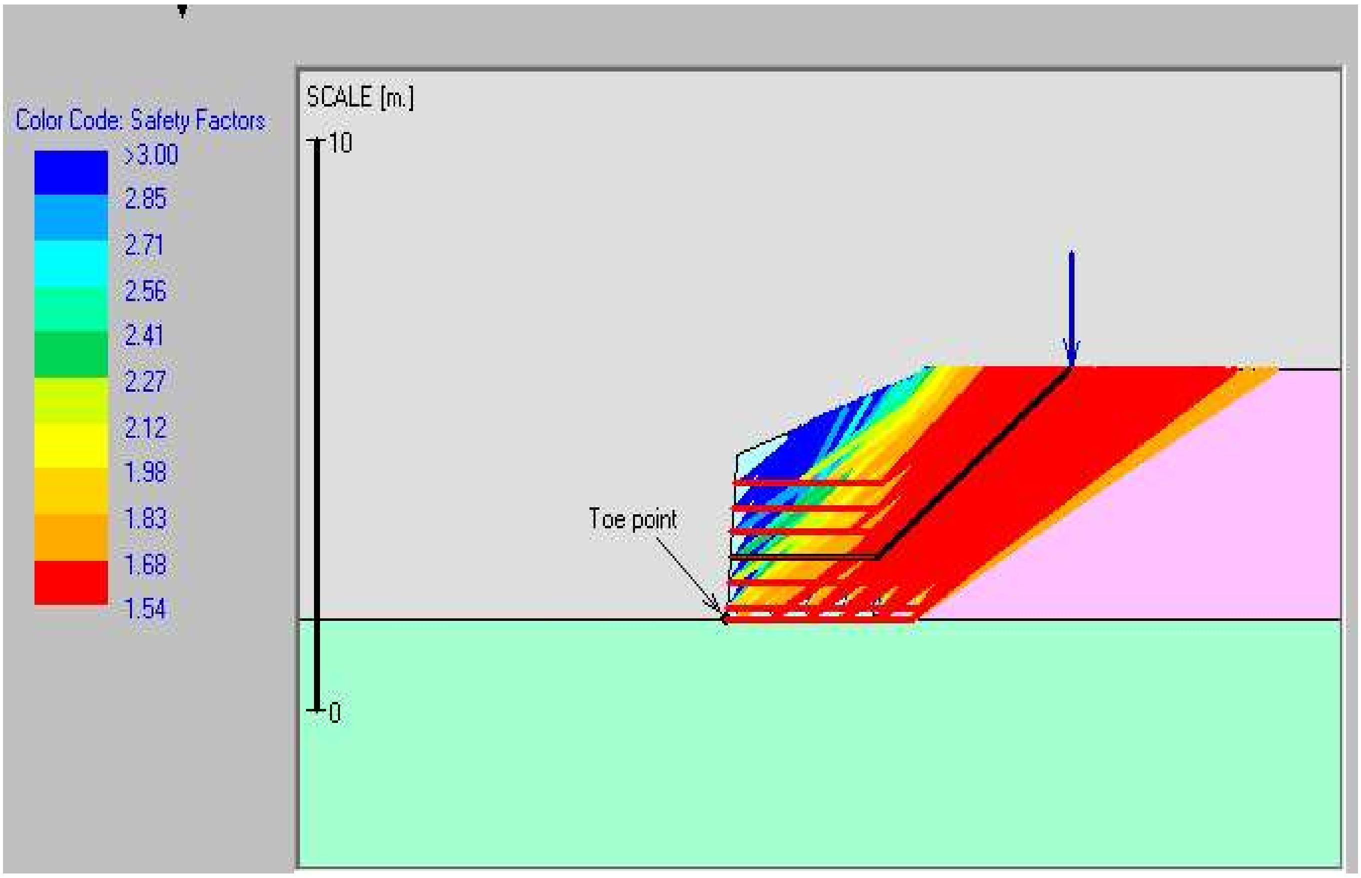
SAFETY MAP: SPENCER TRANSLATIONAL, 2-PART WEDGE



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77+100 overall stability(seismicity)

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PROJECT IDENTIFICATION

Title: 77+100 overall stability(seismicity)
Project Number: -
Client:
Designer: 戴征杰（BOSTD）

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia
,
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+100 overall stability.MSE
Original date and time of creating this file: Mon Apr 12 11:25:38 2021

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

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INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [kN/m^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [kPa]
.1....... Reinforced Soil.................................	19.5	33.0	0.0
.2..	20.0	28.0	0.0
.3..	20.0	28.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [kN/m]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Additional Reduction Factor, RFa	Coverage Ratio, Rc
1	---RW-95	95.70	1.16	1.10	2.23	1.00	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
1	---RW-95	0.77	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Horizontal peak ground acceleration coefficient, Ao = 0.140
Design horizontal seismic coefficient, kh = Am = 0.50 x Ao = 0.070 & design vertical seismic coefficient, kv (down) = 0.000 x kh = 0.000

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DRAWING OF SPECIFIED GEOMETRY - GENERAL - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

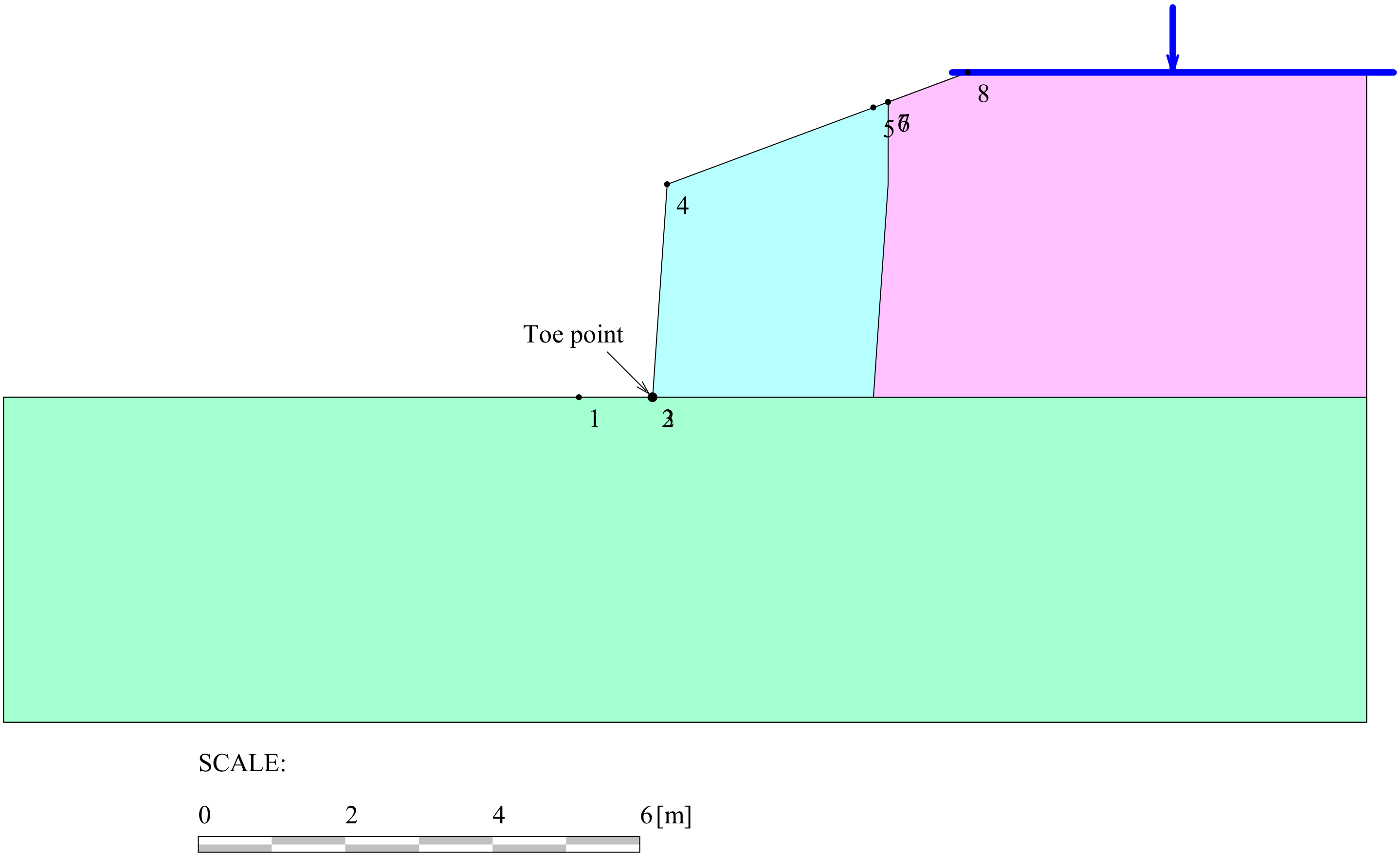
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Surcharge load, Q1....................................None
Surcharge load, Q2....................................None
Surcharge load, Q3....................................None

STRIP LOAD

Strip Load #1.. 10.00 [kPa] Width of base, b = 6.00 [m] Distance from toe point, d = 7.07 [m]



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TABULATED DETAILS OF GEMERAL SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

	#	Xi	Yi
Top of Layer 1	1	-1.00	0.00
	2	-0.00	0.00
	3	0.00	0.00
	4	0.20	2.89
	5	4.28	4.41
Top of Layer 2	6	-1.00	0.00
	7	-0.00	0.00
	8	0.00	0.00
	9	3.00	0.00
	10	3.20	2.89
	11	3.20	4.01
	12	4.28	4.41
Top of Layer 3	13	-1.00	0.00
	14	-0.00	0.00
	15	0.00	0.00

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TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

#	X	Y1	Y2	Y3
1	-1.00	0.00	0.00	0.00
2	-0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.20	2.89	0.00	0.00
5	3.00	3.93	0.00	0.00
6	3.20	4.01	2.89	0.00
7	3.20	4.01	4.01	0.00
8	4.28	4.41	4.41	0.00

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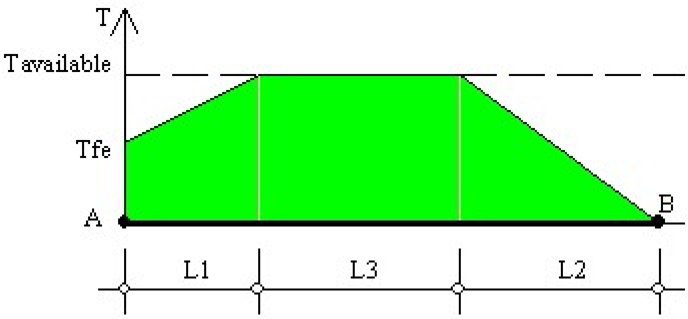
DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER



A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [m]	L [m]	L1 [m]	L2 [m]	L3 [m]	Tfe [kN/m]	Tavailable [kN/m]
1	---RW-95	0.22	4.00	0.00	1.12	2.88	33.63	33.63
2	---RW-95	0.66	3.50	0.00	1.23	2.27	33.63	33.63
3	---RW-95	1.10	3.00	0.00	1.44	1.56	33.63	33.63
4	---RW-95	1.54	3.00	0.00	1.77	1.23	33.63	33.63
5	---RW-95	1.98	3.00	0.00	2.39	0.61	33.63	33.63
6	---RW-95	2.42	3.00	0.00	3.00	0.00	27.45	27.45 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength.

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RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [m]		Exit Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	5.40	4.41	-3.24	0.01	-0.08	4.49	5.48	1.32	
2	6.13	4.41	-3.71	0.02	-0.25	5.49	6.47	1.25	
3	6.86	4.41	-3.77	0.05	-0.15	6.37	7.28	1.21	
. 4	7.59	4.41	-4.22	0.04	-0.29	7.56	8.49	1.20 .	OK
5	8.32	4.41	-4.16	0.01	-0.32	9.01	9.78	1.21	
6	9.05	4.41	-4.24	0.04	-0.32	10.50	11.17	1.24	
7	9.78	4.41	-4.18	0.01	-0.38	12.30	12.86	1.28	
8	10.51	4.41	-4.60	0.00	-0.68	14.65	15.16	1.33	
9	11.24	4.41	-4.70	0.02	-0.73	16.76	17.20	1.40	
10	11.97	4.41	-4.63	0.01	-0.66	18.53	18.95	1.47	
11	12.70	4.41	-4.75	0.03	-0.83	21.36	21.69	1.54	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points).

Exit Point #	Exit Point (X, Y) [m]		Entry Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	-4.72	0.06	7.59	4.41	-0.50	7.71	8.74	1.21	
. 2	-4.22	0.04	7.59	4.41	-0.29	7.56	8.49	1.20 .	OK
3	-3.72	0.02	7.59	4.41	-0.07	7.39	8.23	1.20	
4	-3.32	0.05	7.59	4.41	0.14	7.21	7.96	1.21	
5	-2.80	0.02	7.59	4.41	0.36	7.02	7.68	1.22	
6	-2.37	0.03	7.59	4.41	0.59	6.81	7.40	1.24	
7	-1.93	0.04	7.59	4.41	0.82	6.59	7.11	1.26	
8	-1.46	0.03	7.59	4.41	1.06	6.36	6.81	1.30	
9	-0.94	0.01	8.32	4.41	1.21	7.43	7.73	1.35	
10	-0.48	0.01	8.32	4.41	1.36	7.32	7.54	1.40	
11	-0.00	0.00	8.32	4.41	1.62	7.00	7.19	1.45	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

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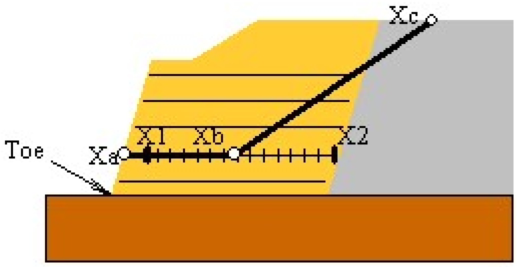
RESULTS OF TRANSLATIONAL ANALYSIS



Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [m]	(Xa, Ya) [m]		(Xb, Yb) [m]		(Xc, Yc) [m]		Fs	STATUS
At toe elevation	0.00	0.00	0.00	3.08	0.00	8.93	4.41	1.37	OK
Reinf. Layer #1	0.22	0.02	0.22	3.99	0.22	8.81	4.41	1.34	Minimum on Edge
Reinf. Layer #2	0.66	0.05	0.66	3.49	0.66	7.96	4.41	1.31	Minimum on Edge
. Reinf. Layer #3	1.10	0.08	1.10	3.09	1.10	7.18	4.41	1.29	Minimum on Edge
Reinf. Layer #4	1.54	0.11	1.54	3.09	1.54	6.63	4.41	1.34	Minimum on Edge
Reinf. Layer #5	1.98	0.14	1.98	3.09	1.98	6.20	4.41	1.37	Minimum on Edge
Reinf. Layer #6	2.42	0.17	2.42	3.19	2.42	5.74	4.41	1.38	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

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CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.20

Critical Circle: Xc = -0.29[m], Yc = 7.56[m], R = 8.49[m]. (Number of slices used = 56)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

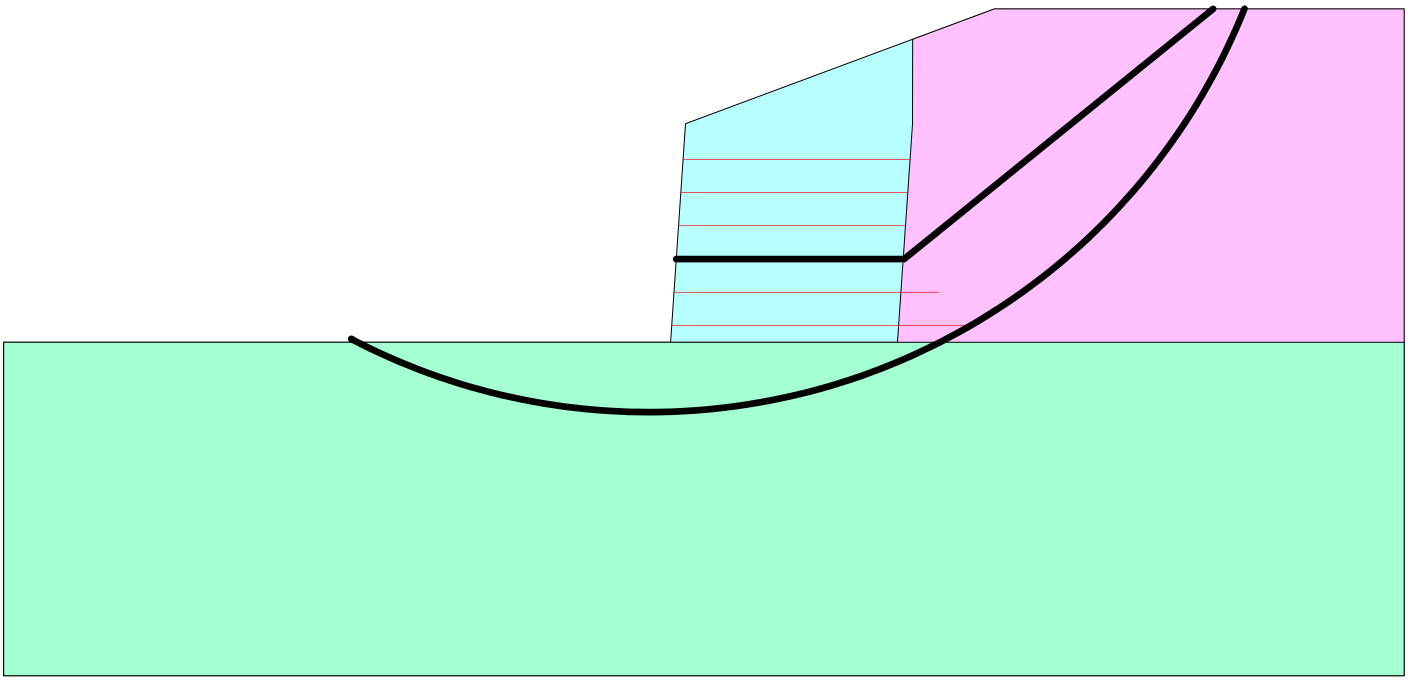
Minimum Factor of Safety = 1.29

Critical Two-Part Wedge: (Xa = 0.08, Ya = 1.10) [m]
(Xb = 3.09, Yb = 1.10) [m]
(Xc = 7.18, Yc = 4.41) [m]
(Number of slices used = 30)
Interslice resultant force inclination = 23.67 [degrees]

Three-Part Wedge Stability Analysis

N O T C O N D U C T E D

REINFORCEMENT LAYOUT: DRAWING



SCALE:

0 2 4 6[m]

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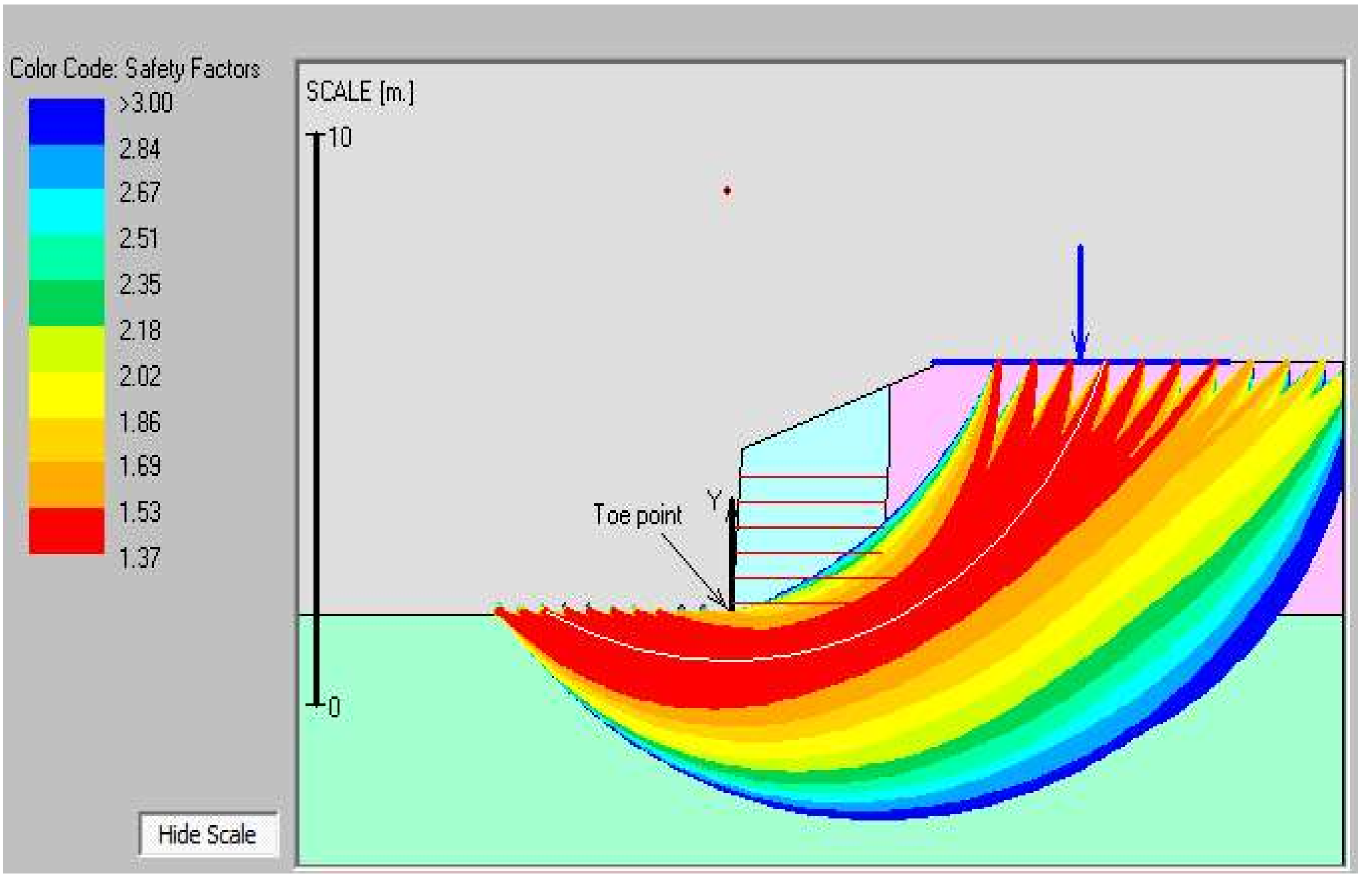
SAFETY MAP: BISHOP ROTATIONAL ANALYSIS MODE



Version 3.0 ReSSA Version 3.0

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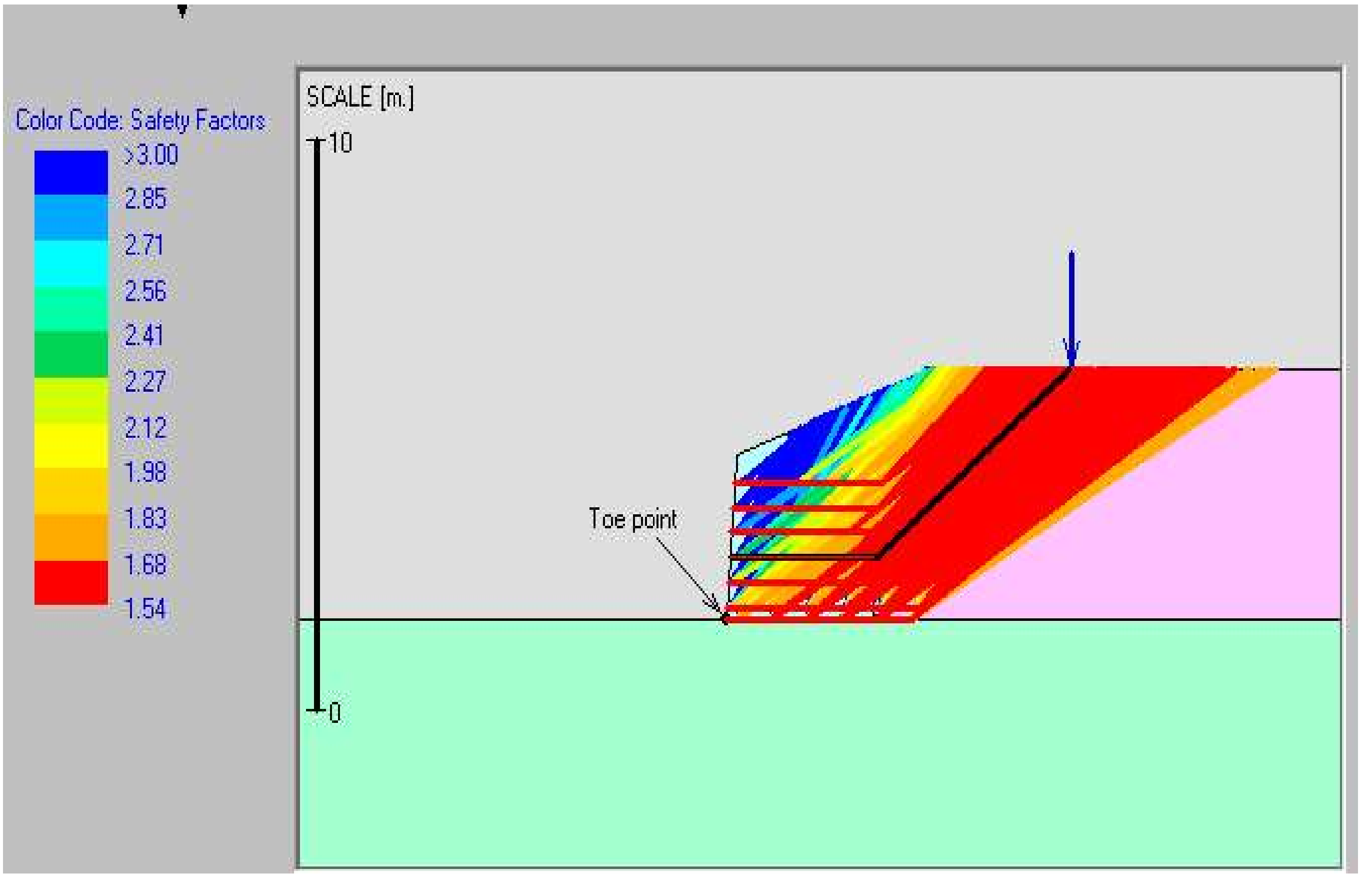
SAFETY MAP: SPENCER TRANSLATIONAL, 2-PART WEDGE



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Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0

Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0

AASHTO 2007 (LRFD)
km77+175（Combination A）

PROJECT IDENTIFICATION

Title: km77+175（Combination A）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+175（Combination A）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0

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Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0

SOIL DATA

REINFORCED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 33.0 °

RETAINED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)
Equivalent unit weight, $\gamma_{equiv.}$ 18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$ 31.0 °
Equivalent cohesion, $c_{equiv.}$ 0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10°Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, Ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3548 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 32.67 N γ= 25.99

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3382 Kae (Kh = 0) = 0.3232 Δ Kae = 0.0150 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

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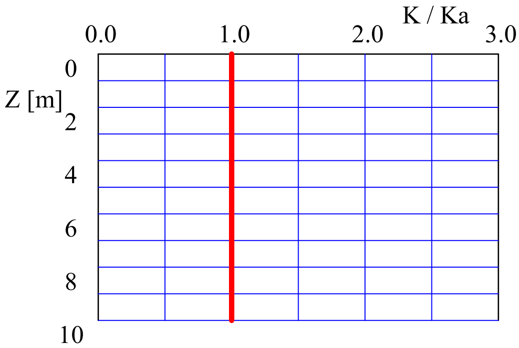
INPUT DATA: Geogrids (Analysis)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	N/A	N/A			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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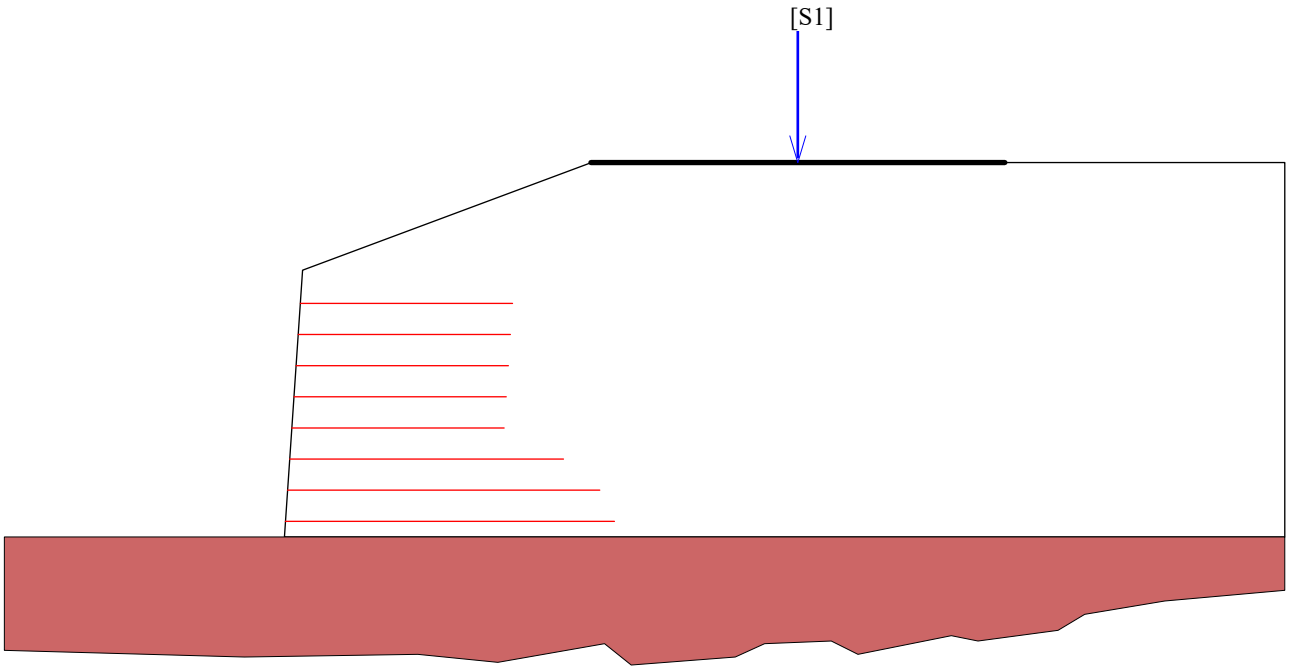
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	3.77	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 3.77 m }
Batter, ω	3.9	[deg]	
Backslope, β	20.4	[deg]	
Backslope rise	1.5	[m]	Broken back equivalent angle, I = 11.40° (see Fig. 25 in DEMO 82)

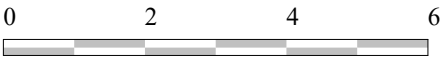
U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 10.0 and Qv-l = 0.0 [kPa].
Footing width, b=5.8 [m]. Distance of center of footing from wall face, d = 7.0 [m] @ depth of 0.0 [m] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.50		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.50		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.77		0.90

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.50	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.50	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.50

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	0.83		0.90
Reinforced Soil and Reinforcement	ϕ_τ	0.77		0.90

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
	ϕ_b	0.74		0.90

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ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 5.12, Meyerhof stress = 149.23 kPa.
Foundation Interface: Direct sliding, CDR = 1.929, Eccentricity, e/L = 0.0392, CDR-overturning = 5.26

GEOGRID #	Elevation [m]	Length [m]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	4.65	1	N/A	N/A	N/A	1.974	13.825	1.535	0.0318	---RW-95
2	0.66	4.41	1	N/A	N/A	N/A	2.215	12.738	1.530	0.0287	---RW-95
3	1.10	3.87	1	N/A	N/A	N/A	2.524	10.368	1.539	0.0240	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	2.932	6.759	1.593	0.0191	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	3.497	6.308	1.782	-0.0020	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	4.333	5.894	2.031	-0.0233	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	5.693	5.495	2.388	-0.0470	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	6.084	3.919	2.793	-0.0802	---RW-95

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, CDR = 8.47, Meyerhof stress = 104.96 kPa.
Foundation Interface: Direct sliding, CDR = 1.859, Eccentricity, e/L = 0.0558, Fs-overturning = 4.49

GEOGRID #	Elevation [m]	Length [m]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	4.65	1	N/A	N/A	N/A	1.907	11.987	1.594	0.0469	---RW-95
2	0.66	4.41	1	N/A	N/A	N/A	2.139	11.034	1.585	0.0439	---RW-95
3	1.10	3.87	1	N/A	N/A	N/A	2.443	9.028	1.603	0.0368	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	2.857	5.972	1.697	0.0270	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	3.401	5.548	1.916	0.0027	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	4.201	5.150	2.216	-0.0210	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	5.492	4.750	2.677	-0.0461	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	5.882	3.405	3.223	-0.0799	---RW-95

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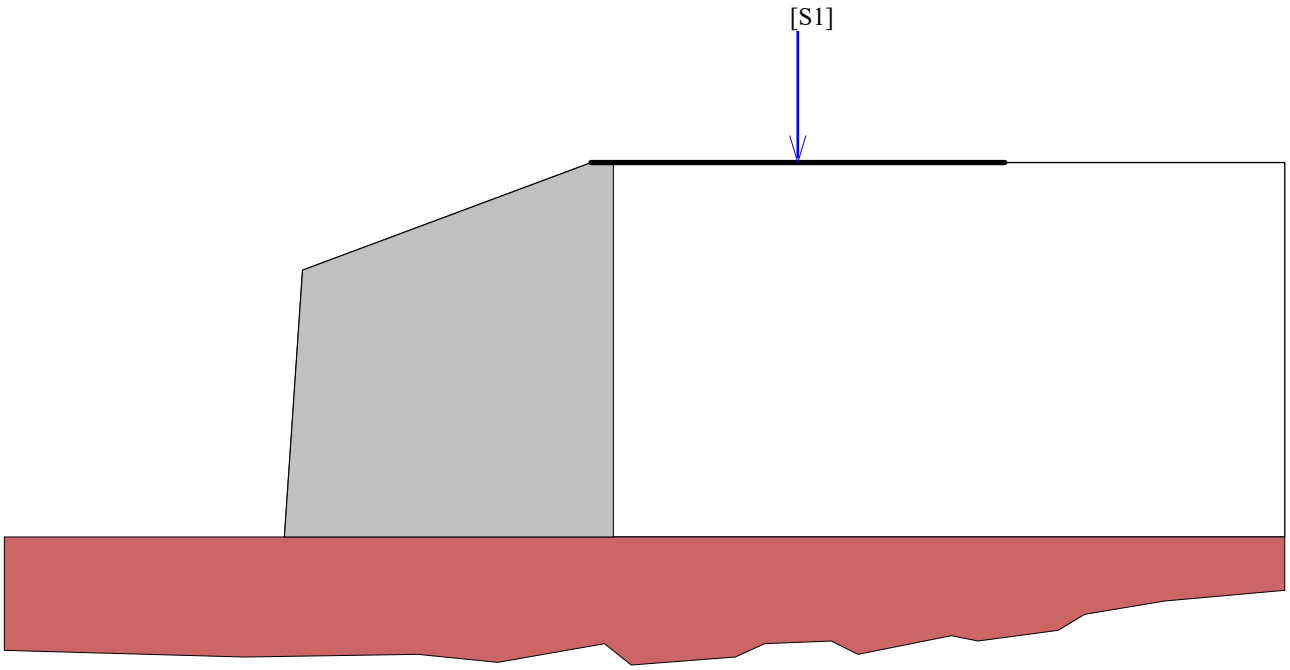
BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	764.4	888.5	[kPa]
Meyerhof stress, σ_V	149.23	105.0	[kPa]
Eccentricity, e	0.18	0.27	[m]
Eccentricity, e/L	0.038	0.058	
CDR calculated	5.12	8.47	
Base length	4.65	4.65	[m]



SCALE:

0 2 4 6 [m]

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DIRECT SLIDING for GIVEN LAYOUT (for GEOGRID reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.929 and CDR-seismic = 1.859

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	4.65	1.535	1.594	1	---RW-95
2	0.66	4.41	1.530	1.585	1	---RW-95
3	1.10	3.87	1.539	1.603	1	---RW-95
4	1.54	3.00	1.593	1.697	1	---RW-95
5	1.98	3.00	1.782	1.916	1	---RW-95
6	2.42	3.00	2.031	2.216	1	---RW-95
7	2.86	3.00	2.388	2.677	1	---RW-95
8	3.30	3.00	2.793	3.223	1	---RW-95

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = 0.0392, e/L seismic = 0.0558; Overturning: CDR-static = 5.26, CDR-seismic = 4.49

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	4.65	0.0318	0.0469	1	---RW-95
2	0.66	4.41	0.0287	0.0439	1	---RW-95
3	1.10	3.87	0.0240	0.0368	1	---RW-95
4	1.54	3.00	0.0191	0.0270	1	---RW-95
5	1.98	3.00	-0.0020	0.0027	1	---RW-95
6	2.42	3.00	-0.0233	-0.0210	1	---RW-95
7	2.86	3.00	-0.0470	-0.0461	1	---RW-95
8	3.30	3.00	-0.0802	-0.0799	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	15.33	1.20	N/A	1.974	N/A	1.907	---RW-95
2	0.66	30.3	13.66	1.09	N/A	2.215	N/A	2.139	---RW-95
3	1.10	30.3	11.99	0.89	N/A	2.524	N/A	2.443	---RW-95
4	1.54	30.3	10.32	0.60	N/A	2.932	N/A	2.857	---RW-95
5	1.98	30.3	8.66	0.55	N/A	3.497	N/A	3.401	---RW-95
6	2.42	30.3	6.99	0.49	N/A	4.333	N/A	4.201	---RW-95
7	2.86	30.3	5.32	0.43	N/A	5.693	N/A	5.492	---RW-95
8	3.30	30.3	4.98	0.38	N/A	6.084	N/A	5.882	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	15.33	1.20	4.54	0.10	212.0	N/A	13.825	198.2	N/A	11.987
2	0.66	1.000	13.66	1.09	4.10	0.31	174.0	N/A	12.738	162.7	N/A	11.034
3	1.10	1.000	11.99	0.89	3.35	0.52	124.4	N/A	10.368	116.3	N/A	9.028
4	1.54	1.000	10.32	0.60	2.27	0.73	69.8	N/A	6.759	65.3	N/A	5.972
5	1.98	1.000	8.66	0.55	2.06	0.94	54.6	N/A	6.308	51.0	N/A	5.548
6	2.42	1.000	6.99	0.49	1.85	1.15	41.2	N/A	5.894	38.5	N/A	5.150
7	2.86	1.000	5.32	0.43	1.64	1.36	29.2	N/A	5.495	27.3	N/A	4.750
8	3.30	1.000	4.98	0.38	1.43	1.57	19.5	N/A	3.919	18.2	N/A	3.405

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AASHTO 2007 (LRFD)
km77+175（Combination B）

PROJECT IDENTIFICATION

Title: km77+175（Combination B）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+175（Combination B）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: DESIGN
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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DESIGN DATA

DESIGN OBJECTIVES

Minimum Capacity Demand Ratio in pullout, CDR-po	1.10
Minimum Capacity Demand Ratio in direct sliding, CDR-sliding	1.10
Maximum allowable eccentricity ratio at each reinforcement level, e/L	0.2500
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-static	1.30
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-seismic	1.10

Prescribed minimum resistive length to prevent pullout, Le = 1.00 m.
Prescribed minimum normalized length of each layer is: L/Hd = 0.70 --> L = 2.64 m.
Prescribed minimum absolute total length of each layer is: L = 3.00 m.

BEARING CAPACITY

Bearing capacity is controlled by general shear.

Maximum permissible eccentricity ratio (soil), e/L	0.2500
Min. Capacity Demand Ratio with respect to ultimate bearing capacity (Meyerhof approach)	1.10

Bearing capacity coefficients: Nc = 32.67 N γ= 25.99

SOIL DATA

REINFORCED SOIL

Unit weight, γ	19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ	33.0 °

RETAINED SOIL

Unit weight, γ	19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	31.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3548 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3382 Kae (Kh = 0) = 0.3232 Δ Kae = 0.0150 (see eq. 37 in DEMO 82)

DIRECT SLIDING / ECCENTRICITY

Seismic CDR is 100.0% of specified static CDR for direct sliding.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

BEARING CAPACITY

Seismic CDR is 100.0% of specified static CDR for bearing capacity.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

INTERNAL STABILITY

Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.
Seismic Capacity Demand Ratio in pullout, CDR-po, is 100.0% of its specified static value.
Seismic Capacity Demand Ratio, CDR-overall, is 100.0% of its specified static value.
The reduction of CDR pertains to geogrid strength and to connection strength for break mode of failure.

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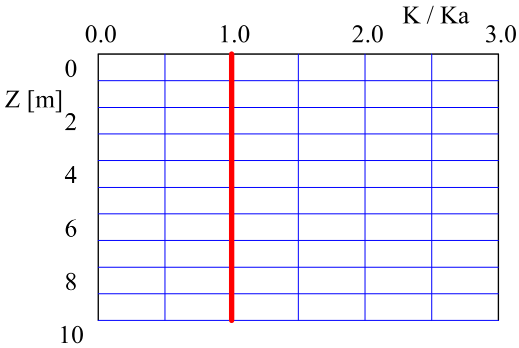
INPUT DATA: Geogrids
(Multiple type reinforcement)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	1.00	1.00			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tan ϕ	0.67tan ϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

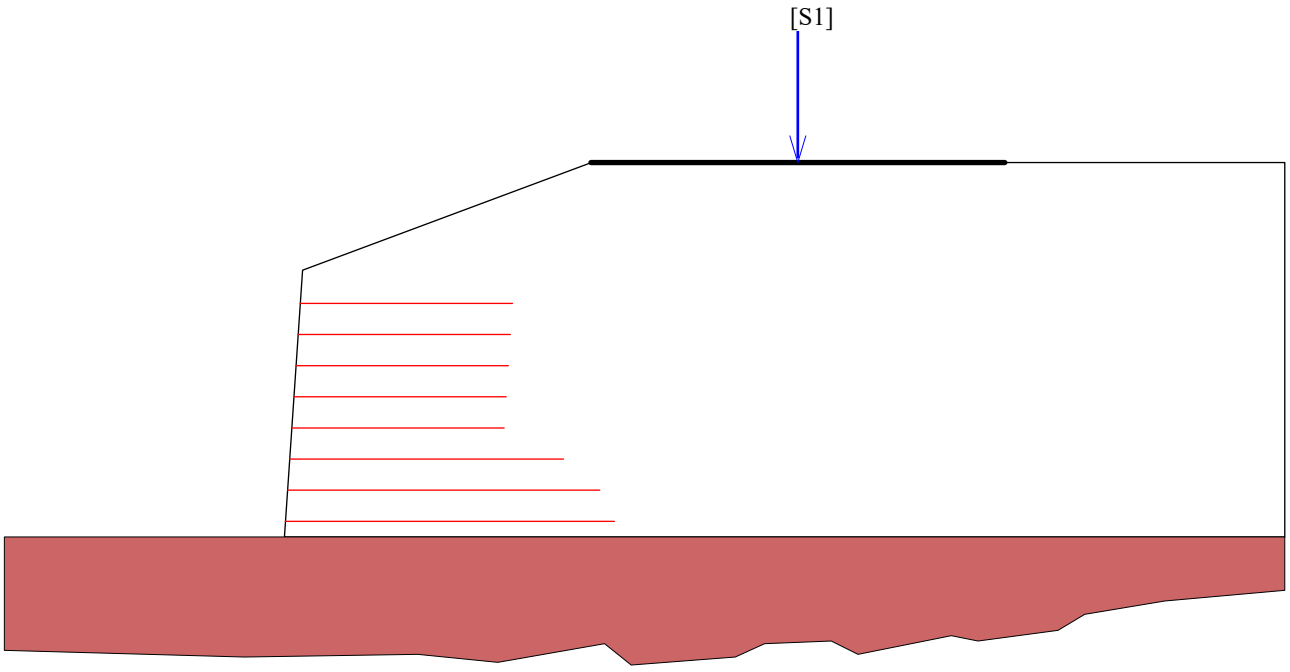
Design height, Hd 3.77 [m] { Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 3.77 m }
Batter, ω 3.9 [deg]
Backslope, β 20.4 [deg]
Backslope rise 1.5 [m]

Broken back equivalent angle, I = 11.40°(see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 10.0 and Qv-l = 0.0 [kPa].
Footing width, b=5.8 [m]. Distance of center of footing from wall face, d = 7.0 [m] @ depth of 0.0 [m] below soil surface.

DESIGNED REINFORCEMENT LAYOUT:



SCALE:

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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.00		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.00		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.00		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.77		0.90

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	0.83		0.90
Reinforced Soil and Reinforcement	ϕ_τ	0.77		0.90

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
	ϕ_b	0.74		0.90

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REINFORCEMENT LAYOUT AND DESIGN CRITERIA

LEGEND:
(1) Connection strength — √ Satisfactory
(2) Geogrid strength — ⊗ Unsatisfactory
(3) Pullout resistance
(4) Direct sliding
(5) Eccentricity

Bearing capacity: √
Foudation Interface: Direct sliding √ Eccentricity √

#	Geogrid Elevation [m]	Geogrid Length [m]	Geogrid Type #	(1)	(2)	(3)	(4)	(5)
1	0.22	4.65	1	N/A	√	√	√	√
2	0.66	4.41	1	N/A	√	√	√	√
3	1.10	3.87	1	N/A	√	√	√	√
4	1.54	3.00	1	N/A	√	√	√	√

#	Geogrid Elevation [m]	Geogrid Length [m]	Geogrid Type #	(1)	(2)	(3)	(4)	(5)
5	1.98	3.00	1	N/A	√	√	√	√
6	2.42	3.00	1	N/A	√	√	√	√
7	2.86	3.00	1	N/A	√	√	√	√
8	3.30	3.00	1	N/A	√	√	√	√

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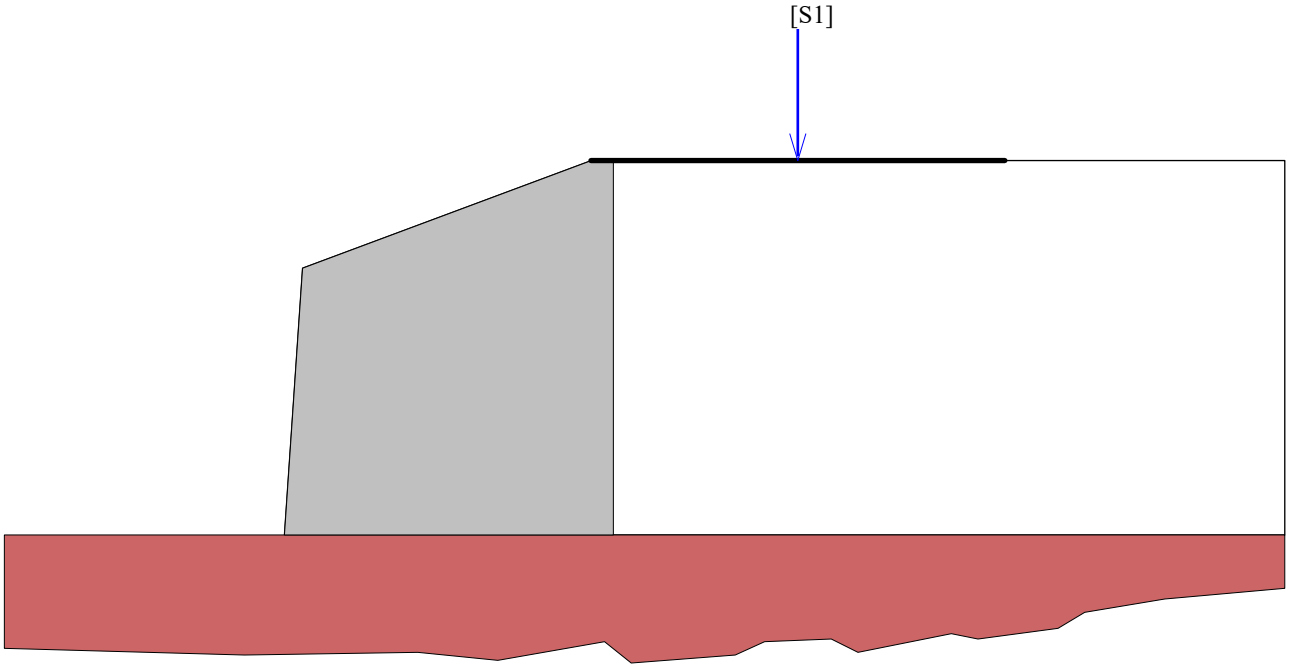
Version 3.0 MSEW Version 3.0 MSEW Version 3.0 MSEW Version 3.0

BEARING CAPACITY for DESIGNED LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	715.7	918.4	[kPa]
Meyerhof stress, σ_V	108.63	100.8	[kPa]
Eccentricity, e	0.31	0.20	[m]
Eccentricity, e/L	0.067	0.044	
CDR calculated	6.59	9.11	
Base length	4.65	4.65	[m]



SCALE:

0 2 4 6 [m]

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DIRECT SLIDING for DESIGNED LAYOUT
(for GEOGRID reinforcements)

Specified CDR-static = 1.100 and CDR-seismic = 1.100

Along reinforced and foundation soils interface: CDR-static = 1.382 and CDR-seismic = 2.013

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	4.65	1.101	1.729	1	---RW-95
2	0.66	4.41	1.101	1.727	1	---RW-95
3	1.10	3.87	1.101	1.736	1	---RW-95
4	1.54	3.00	1.115	1.790	1	---RW-95
5	1.98	3.00	1.242	2.013	1	---RW-95
6	2.42	3.00	1.407	2.310	1	---RW-95
7	2.86	3.00	1.632	2.738	1	---RW-95
8	3.30	3.00	1.888	3.237	1	---RW-95

ECCENTRICITY for DESIGNED LAYOUT

At interface with foundation: e/L static = 0.0674, e/L seismic = 0.0433; Overturning: CDR-static = 3.95, CDR-seismic = 5.03

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	4.65	0.0573	0.0351	1	---RW-95
2	0.66	4.41	0.0533	0.0320	1	---RW-95
3	1.10	3.87	0.0493	0.0277	1	---RW-95
4	1.54	3.00	0.0476	0.0235	1	---RW-95
5	1.98	3.00	0.0194	0.0008	1	---RW-95
6	2.42	3.00	-0.0081	-0.0218	1	---RW-95
7	2.86	3.00	-0.0368	-0.0463	1	---RW-95
8	3.30	3.00	-0.0740	-0.0800	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	10.2	1.2	1.000	2.961	1.000	2.813	---RW-95
2	0.66	30.3	9.1	1.1	1.000	3.323	1.000	3.154	---RW-95
3	1.10	30.3	8.0	0.9	1.000	3.786	1.000	3.606	---RW-95
4	1.54	30.3	6.9	0.6	1.000	4.398	1.000	4.232	---RW-95
5	1.98	30.3	5.8	0.5	1.000	5.246	1.000	5.032	---RW-95
6	2.42	30.3	4.7	0.5	1.000	6.499	1.000	6.206	---RW-95
7	2.86	30.3	3.5	0.4	1.000	8.540	1.000	8.095	---RW-95
8	3.30	30.3	3.3	0.4	1.000	9.125	1.000	8.680	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	10.22	1.20	4.54	0.10	212.0	1.100	20.738	198.2	1.100	17.349
2	0.66	1.000	9.11	1.09	4.10	0.31	174.0	1.100	19.106	162.7	1.100	15.963
3	1.10	1.000	8.00	0.89	3.35	0.52	124.4	1.100	15.552	116.3	1.100	13.091
4	1.54	1.000	6.88	0.60	2.27	0.73	69.8	1.100	10.138	65.3	1.100	8.719
5	1.98	1.000	5.77	0.55	2.06	0.94	54.6	1.100	9.462	51.0	1.100	8.083
6	2.42	1.000	4.66	0.49	1.85	1.15	41.2	1.100	8.841	38.5	1.100	7.479
7	2.86	1.000	3.54	0.43	1.64	1.36	29.2	1.100	8.243	27.3	1.100	6.865
8	3.30	1.000	3.32	0.38	1.43	1.57	19.5	1.100	5.879	18.2	1.100	4.933

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AASHTO 2007 (LRFD)
km77+175（Combination C）

PROJECT IDENTIFICATION

Title: km77+175（Combination C）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+175（Combination C）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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SOIL DATA

REINFORCED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 33.0 °

RETAINED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)
Equivalent unit weight, $\gamma_{equiv.}$ 18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$ 31.0 °
Equivalent cohesion, $c_{equiv.}$ 0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3548 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 32.67 N γ= 25.99

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3382 Kae (Kh = 0) = 0.3232 Δ Kae = 0.0150 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

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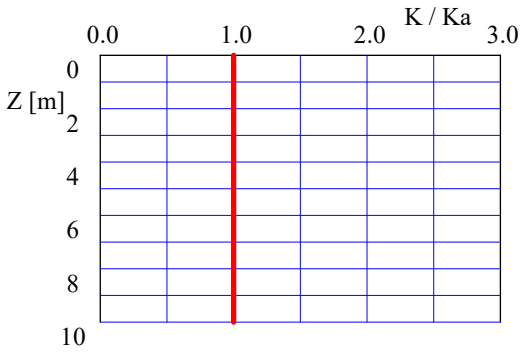
INPUT DATA: Geogrids (Analysis)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	N/A	N/A			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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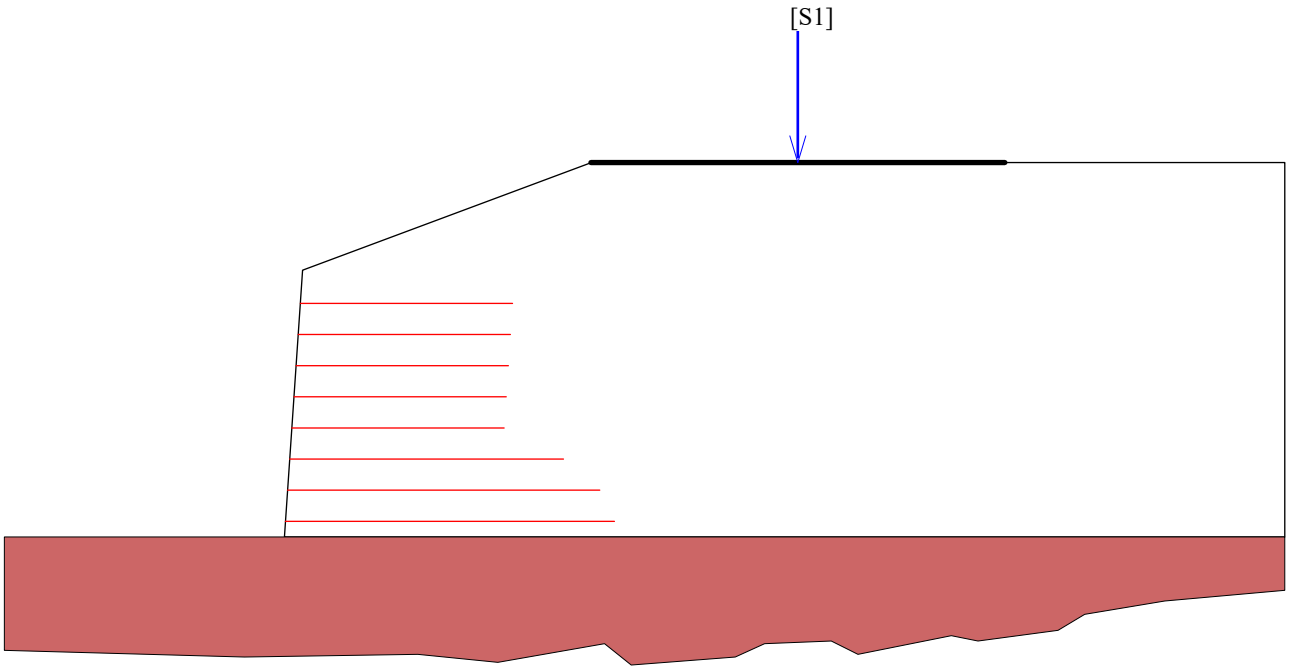
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	3.77	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 3.77 m }
Batter, ω	3.9	[deg]	
Backslope, β	20.4	[deg]	
Backslope rise	1.5	[m]	Broken back equivalent angle, I = 11.40° (see Fig. 25 in DEMO 82)

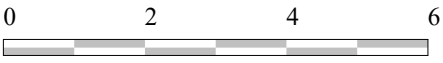
U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 10.0 and Qv-l = 0.0 [kPa].
Footing width, b=5.8 [m]. Distance of center of footing from wall face, d = 7.0 [m] @ depth of 0.0 [m] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.00	
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00	
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.00	
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.00	

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	1.00

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	1.00	1.00

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.00
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic
	ϕ_b	1.00	1.00

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ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 10.38, Meyerhof stress = 99.49 kPa.

Foundation Interface: Direct sliding, CDR = 2.330, Eccentricity, e/L = 0.0380, CDR-overturning = 5.28

GEOGRID				CONNECTION							
#	Elevation [m]	Length [m]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	4.65	1	N/A	N/A	N/A	2.961	26.933	1.998	0.0305	---RW-95
2	0.66	4.41	1	N/A	N/A	N/A	3.323	24.813	1.989	0.0281	---RW-95
3	1.10	3.87	1	N/A	N/A	N/A	3.786	20.198	1.998	0.0240	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	4.398	13.167	2.069	0.0191	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	5.246	12.288	2.314	-0.0020	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	6.499	11.481	2.638	-0.0233	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	8.540	10.705	3.101	-0.0470	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	9.125	7.635	3.628	-0.0802	---RW-95

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, CDR = 10.13, Meyerhof stress = 100.77 kPa.

Foundation Interface: Direct sliding, CDR = 2.236, Eccentricity, e/L = 0.0433, Fs-overturning = 5.03

GEOGRID				CONNECTION							
#	Elevation [m]	Length [m]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	4.65	1	N/A	N/A	N/A	3.125	19.277	1.921	0.0351	---RW-95
2	0.66	4.41	1	N/A	N/A	N/A	3.505	17.737	1.919	0.0320	---RW-95
3	1.10	3.87	1	N/A	N/A	N/A	4.007	14.546	1.929	0.0277	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	4.702	9.688	1.989	0.0235	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	5.592	8.981	2.236	0.0008	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	6.896	8.310	2.566	-0.0218	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	8.994	7.628	3.042	-0.0463	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	9.645	5.481	3.597	-0.0800	---RW-95

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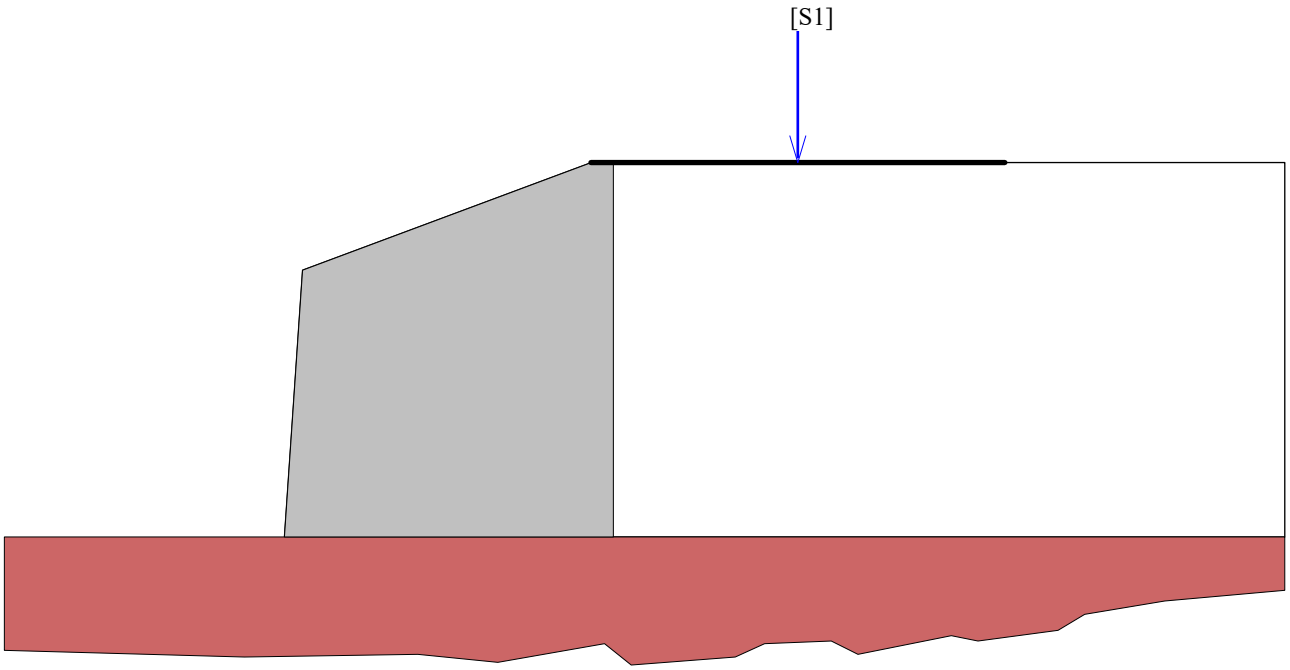
BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	1032.9	1020.5	[kPa]
Meyerhof stress, σ_V	99.49	100.8	[kPa]
Eccentricity, e	0.18	0.20	[m]
Eccentricity, e/L	0.038	0.044	
CDR calculated	10.38	10.13	
Base length	4.65	4.65	[m]



SCALE:

0 2 4 6 [m]

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DIRECT SLIDING for GIVEN LAYOUT
(for GEOGRID reinforcements)

Along reinforced and foundation soils interface: CDR-static = 2.330 and CDR-seismic = 2.236

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	4.65	1.998	1.921	1	---RW-95
2	0.66	4.41	1.989	1.919	1	---RW-95
3	1.10	3.87	1.998	1.929	1	---RW-95
4	1.54	3.00	2.069	1.989	1	---RW-95
5	1.98	3.00	2.314	2.236	1	---RW-95
6	2.42	3.00	2.638	2.566	1	---RW-95
7	2.86	3.00	3.101	3.042	1	---RW-95
8	3.30	3.00	3.628	3.597	1	---RW-95

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = 0.0380, e/L seismic = 0.0433; Overturning: CDR-static = 5.28, CDR-seismic = 5.03

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	4.65	0.0305	0.0351	1	---RW-95
2	0.66	4.41	0.0281	0.0320	1	---RW-95
3	1.10	3.87	0.0240	0.0277	1	---RW-95
4	1.54	3.00	0.0191	0.0235	1	---RW-95
5	1.98	3.00	-0.0020	0.0008	1	---RW-95
6	2.42	3.00	-0.0233	-0.0218	1	---RW-95
7	2.86	3.00	-0.0470	-0.0463	1	---RW-95
8	3.30	3.00	-0.0802	-0.0800	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	10.22	1.20	N/A	2.961	N/A	3.125	---RW-95
2	0.66	30.3	9.11	1.09	N/A	3.323	N/A	3.505	---RW-95
3	1.10	30.3	8.00	0.89	N/A	3.786	N/A	4.007	---RW-95
4	1.54	30.3	6.88	0.60	N/A	4.398	N/A	4.702	---RW-95
5	1.98	30.3	5.77	0.55	N/A	5.246	N/A	5.592	---RW-95
6	2.42	30.3	4.66	0.49	N/A	6.499	N/A	6.896	---RW-95
7	2.86	30.3	3.54	0.43	N/A	8.540	N/A	8.994	---RW-95
8	3.30	30.3	3.32	0.38	N/A	9.125	N/A	9.645	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	10.22	1.20	4.54	0.10	275.3	N/A	26.933	220.2	N/A	19.277
2	0.66	1.000	9.11	1.09	4.10	0.31	226.0	N/A	24.813	180.8	N/A	17.737
3	1.10	1.000	8.00	0.89	3.35	0.52	161.5	N/A	20.198	129.2	N/A	14.546
4	1.54	1.000	6.88	0.60	2.27	0.73	90.6	N/A	13.167	72.5	N/A	9.688
5	1.98	1.000	5.77	0.55	2.06	0.94	70.9	N/A	12.288	56.7	N/A	8.981
6	2.42	1.000	4.66	0.49	1.85	1.15	53.5	N/A	11.481	42.8	N/A	8.310
7	2.86	1.000	3.54	0.43	1.64	1.36	37.9	N/A	10.705	30.4	N/A	7.628
8	3.30	1.000	3.32	0.38	1.43	1.57	25.3	N/A	7.635	20.3	N/A	5.481

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77+175 overall stability(no seismicity)

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PROJECT IDENTIFICATION

Title: 77+175 overall stability(no seismicity)
Project Number: -
Client:
Designer: 戴征杰（BOSTD）

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia
,
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+175 overall stability.MSE
Original date and time of creating this file: Thu Apr 08 14:53:29 2021

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0

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INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [kN/m^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [kPa]
1....... Reinforced Soil.................................	19.5	33.0	0.0
2..	20.0	28.0	0.0
3....... Foundation Soil.................................	18.5	31.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [kN/m]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Additional Reduction Factor, RFa	Coverage Ratio, Rc
1	---RW-95	95.70	1.16	1.10	2.23	1.00	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
1	---RW-95	0.77	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Not Applicable

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DRAWING OF SPECIFIED GEOMETRY - GENERAL - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

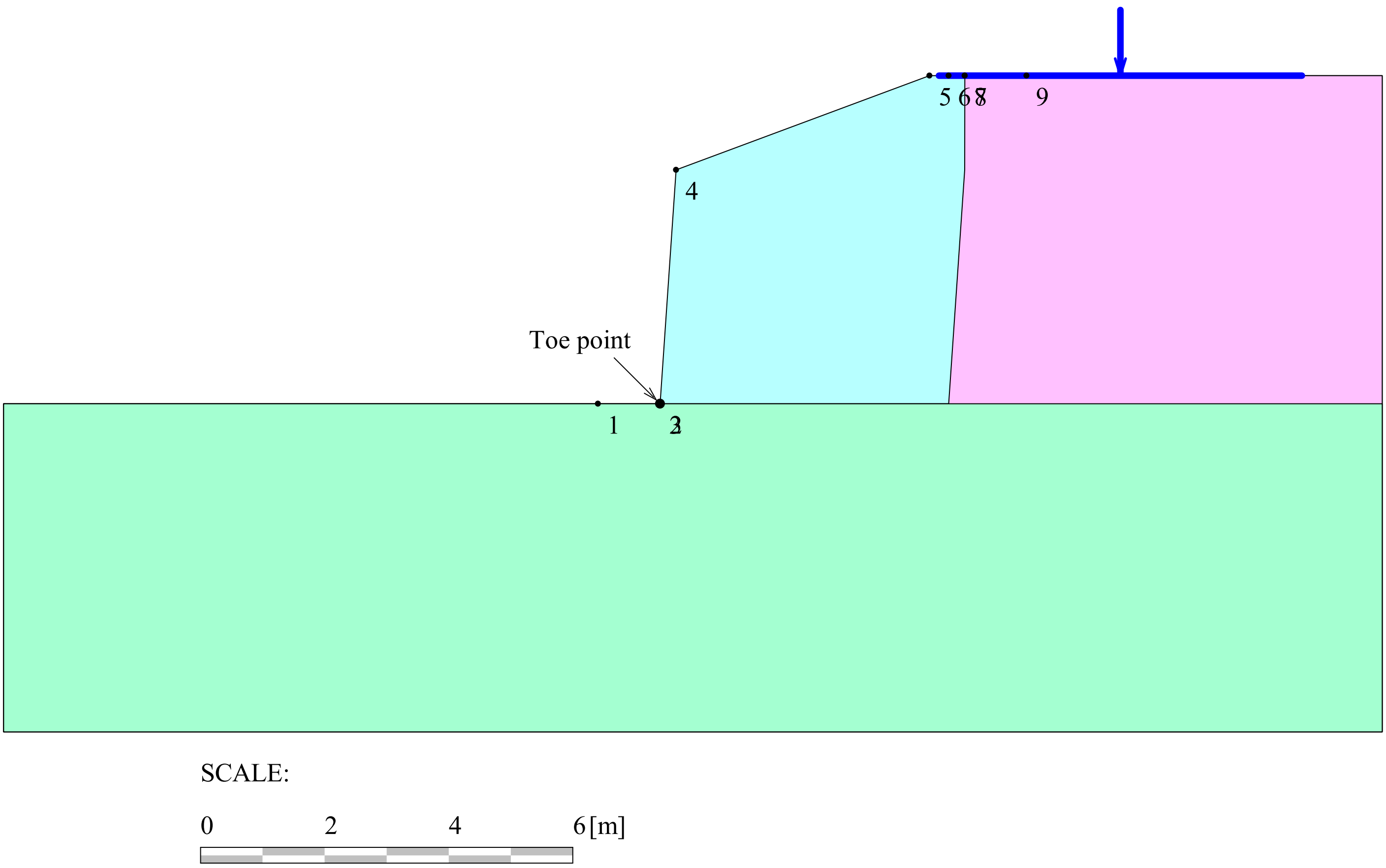
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Surcharge load, Q1....................................None
Surcharge load, Q2....................................None
Surcharge load, Q3....................................None

STRIP LOAD

Strip Load #1.. 10.00 [kPa] Width of base, b = 5.85 [m] Distance from toe point, d = 7.42 [m]



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TABULATED DETAILS OF GEMERAL SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

	#	Xi	Yi
Top of Layer 1	1	-1.00	0.00
	2	-0.00	0.00
	3	0.00	0.00
	4	0.26	3.77
	5	4.34	5.29
Top of Layer 2	6	-1.00	0.00
	7	-0.00	0.00
	8	0.00	0.00
	9	4.65	0.00
	10	4.91	3.77
	11	4.91	5.29
	12	5.91	5.29
Top of Layer 3	13	-1.00	0.00
	14	-0.00	0.00
	15	0.00	0.00

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TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

#	X	Y1	Y2	Y3
1	-1.00	0.00	0.00	0.00
2	-0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.26	3.77	0.00	0.00
5	4.34	5.29	0.00	0.00
6	4.65	5.29	0.00	0.00
7	4.91	5.29	3.77	0.00
8	4.91	5.29	5.29	0.00
9	5.91	5.29	5.29	0.00

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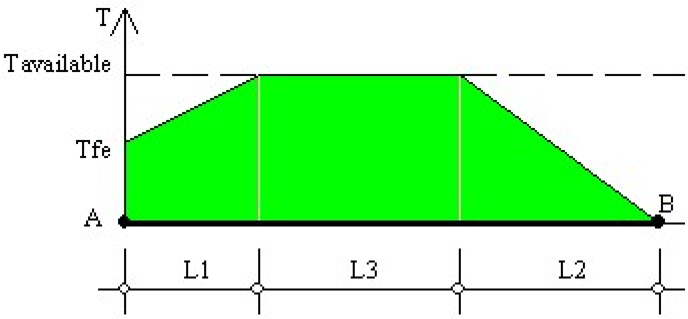
DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER



A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [m]	L [m]	L1 [m]	L2 [m]	L3 [m]	Tfe [kN/m]	Tavailable [kN/m]
1	---RW-95	0.22	4.65	0.00	0.74	3.91	33.63	33.63
2	---RW-95	0.66	4.41	0.00	0.83	3.58	33.63	33.63
3	---RW-95	1.10	3.87	0.00	0.97	2.90	33.63	33.63
4	---RW-95	1.54	3.00	0.00	1.22	1.78	33.63	33.63
5	---RW-95	1.98	3.00	0.00	1.44	1.56	33.63	33.63
6	---RW-95	2.42	3.00	0.00	1.77	1.23	33.63	33.63
7	---RW-95	2.86	3.00	0.00	2.39	0.61	33.63	33.63
8	---RW-95	3.30	3.00	0.00	3.00	0.00	27.46	27.46 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength.

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RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [m]		Exit Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	3.90	5.13	-6.68	0.06	-2.65	5.24	6.56	3.09	
2	4.72	5.29	-5.37	0.06	-1.69	5.32	6.41	2.27	
3	5.54	5.29	-4.71	0.06	-0.98	5.40	6.52	1.85	
4	6.36	5.29	-4.63	0.00	-0.44	5.36	6.80	1.65	
5	7.18	5.29	-4.05	0.07	0.17	5.68	7.02	1.55	
6	8.00	5.29	-4.63	0.00	-0.18	7.11	8.38	1.50	
. 7	8.82	5.29	-4.71	0.05	-0.16	8.39	9.50	1.48 .	OK
8	9.64	5.29	-5.38	0.05	-0.51	10.23	11.29	1.50	
9	10.46	5.29	-6.03	0.04	-0.91	12.46	13.44	1.54	
10	11.28	5.29	-5.41	0.04	-0.55	13.75	14.54	1.61	
11	12.10	5.29	-6.05	0.04	-0.94	16.35	17.10	1.69	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points).

Exit Point #	Exit Point (X, Y) [m]		Entry Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	-6.65	0.03	8.82	5.29	-1.19	9.36	10.81	1.53	
2	-6.02	0.05	8.82	5.29	-0.80	8.90	10.28	1.50	
3	-5.30	0.01	8.82	5.29	-0.48	8.65	9.89	1.49	
. 4	-4.71	0.05	8.82	5.29	-0.16	8.39	9.50	1.48 .	OK
5	-4.09	0.07	8.82	5.29	0.17	8.11	9.10	1.49	
6	-3.36	0.03	8.00	5.29	0.50	6.59	7.61	1.51	
7	-2.65	0.00	8.82	5.29	0.77	7.67	8.39	1.55	
8	-2.08	0.04	8.82	5.29	1.13	7.32	7.96	1.60	
9	-1.36	0.01	8.82	5.29	1.41	7.12	7.63	1.67	
10	-0.74	0.02	9.64	5.29	1.67	8.13	8.46	1.77	
11	-0.00	0.00	9.64	5.29	1.96	7.86	8.10	1.88	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

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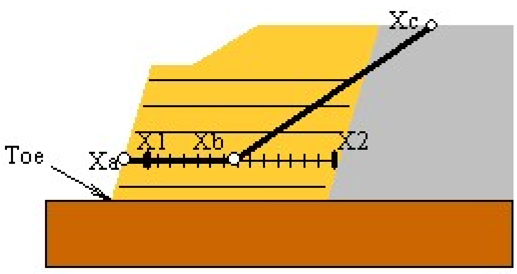
RESULTS OF TRANSLATIONAL ANALYSIS



Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [m]	(Xa, Ya) [m]		(Xb, Yb) [m]		(Xc, Yc) [m]		Fs	STATUS
. At toe elevation	0.00	0.00	0.00	0.20	0.00	8.04	5.29	1.54	Minimum on Edge
Reinf. Layer #1	0.22	0.02	0.22	1.02	0.22	8.26	5.29	1.65	OK
Reinf. Layer #2	0.66	0.05	0.66	1.82	0.66	8.43	5.29	1.69	OK
Reinf. Layer #3	1.10	0.08	1.10	2.47	1.10	8.03	5.29	1.69	OK
Reinf. Layer #4	1.54	0.11	1.54	3.09	1.54	7.72	5.29	1.60	Minimum on Edge
Reinf. Layer #5	1.98	0.14	1.98	3.09	1.98	7.03	5.29	1.66	Minimum on Edge
Reinf. Layer #6	2.42	0.17	2.42	3.19	2.42	7.00	5.29	1.72	Minimum on Edge
Reinf. Layer #7	2.86	0.20	2.86	3.19	2.86	6.53	5.29	1.79	Minimum on Edge
Reinf. Layer #8	3.30	0.23	3.30	3.19	3.30	5.83	5.29	1.85	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

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CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.48
Critical Circle: Xc = -0.16[m], Yc = 8.39[m], R = 9.50[m]. (Number of slices used = 57)

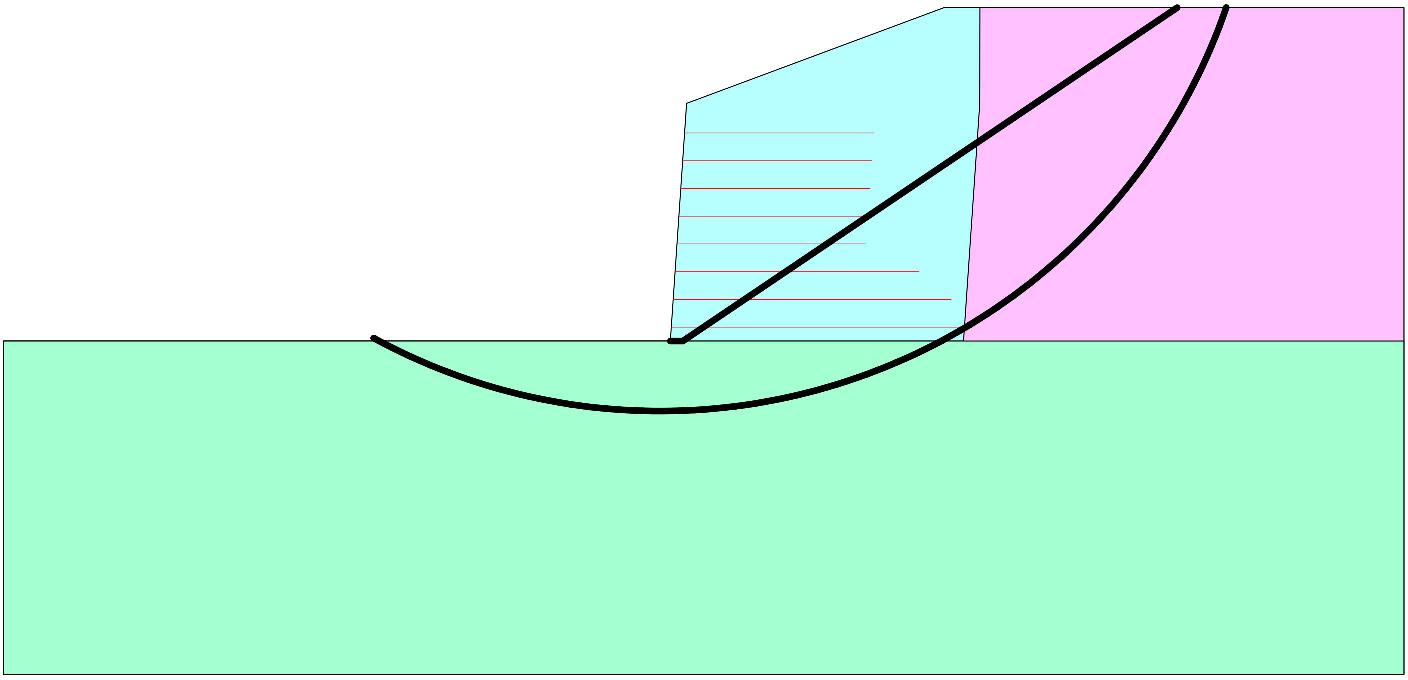
Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

Minimum Factor of Safety = 1.54
Critical Two-Part Wedge: (Xa = 0.00, Ya = 0.00) [m]
(Xb = 0.20, Yb = 0.00) [m]
(Xc = 8.04, Yc = 5.29) [m]
(Number of slices used = 30)
Interslice resultant force inclination = 33.97 [degrees]

Three-Part Wedge Stability Analysis

N O T C O N D U C T E D

REINFORCEMENT LAYOUT: DRAWING



SCALE:

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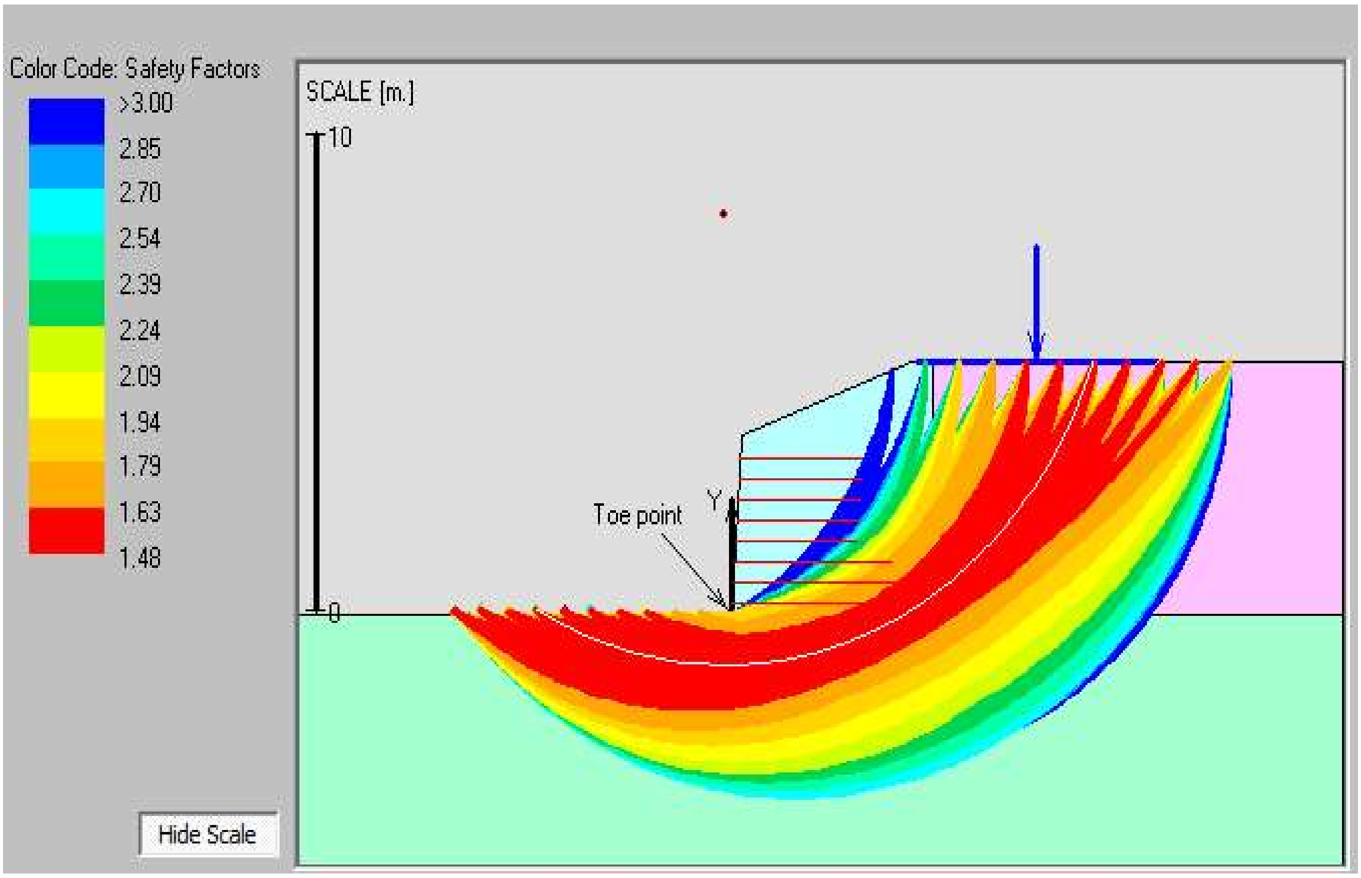
SAFETY MAP: BISHOP ROTATIONAL ANALYSIS MODE



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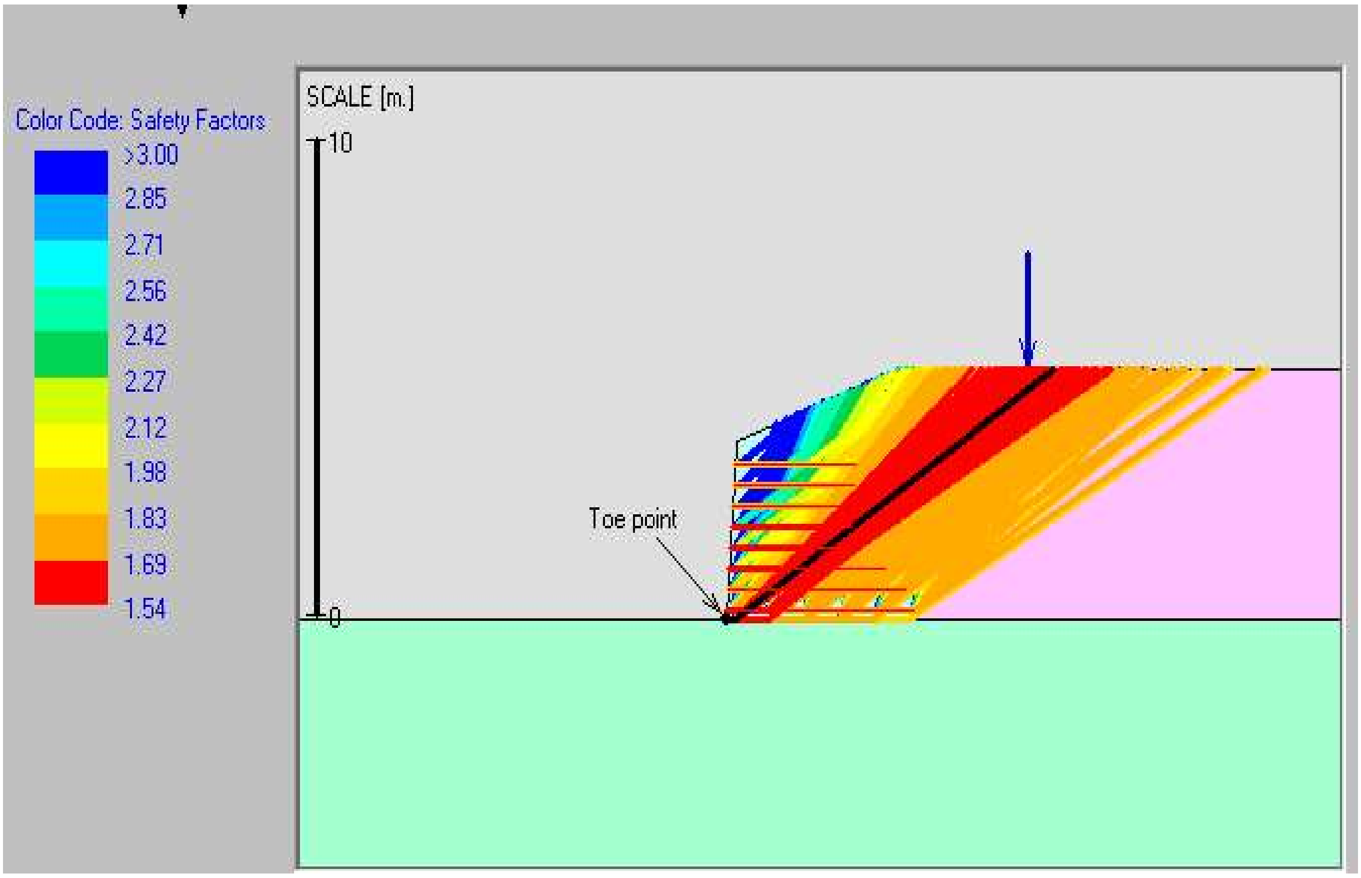
SAFETY MAP: SPENCER TRANSLATIONAL, 2-PART WEDGE



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77+175 overall stability(seismicity)

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PROJECT IDENTIFICATION

Title: 77+175 overall stability(seismicity)
Project Number: -
Client:
Designer: 戴征杰（BOSTD）

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia
,
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+175 overall stability.MSE
Original date and time of creating this file: Thu Apr 08 14:53:29 2021

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

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INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [kN/m^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [kPa]
.1....... Reinforced Soil.................................	19.5	33.0	0.0
.2..	20.0	28.0	0.0
.3....... Foundation Soil.................................	18.5	31.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [kN/m]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Additional Reduction Factor, RFa	Coverage Ratio, Rc
1	---RW-95	95.70	1.16	1.10	2.23	1.00	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
1	---RW-95	0.77	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Horizontal peak ground acceleration coefficient, Ao = 0.140
Design horizontal seismic coefficient, kh = Am = 0.50 x Ao = 0.070 & design vertical seismic coefficient, kv (down) = 0.000 x kh = 0.000

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DRAWING OF SPECIFIED GEOMETRY - GENERAL - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

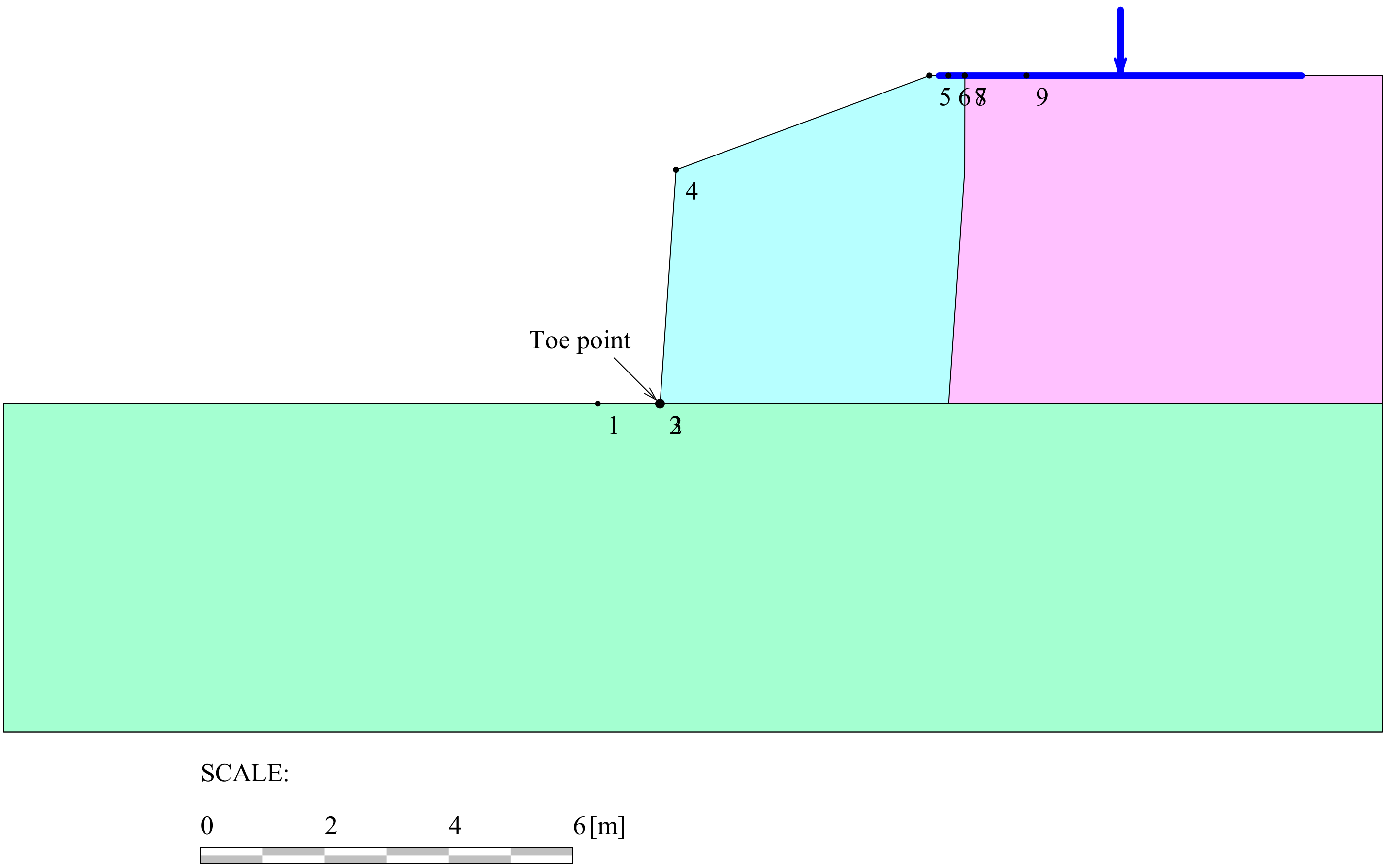
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Surcharge load, Q1....................................None
Surcharge load, Q2....................................None
Surcharge load, Q3....................................None

STRIP LOAD

Strip Load #1.. 10.00 [kPa] Width of base, b = 5.85 [m] Distance from toe point, d = 7.42 [m]



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TABULATED DETAILS OF GEMERAL SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

	#	Xi	Yi
Top of Layer 1	1	-1.00	0.00
	2	-0.00	0.00
	3	0.00	0.00
	4	0.26	3.77
	5	4.34	5.29
Top of Layer 2	6	-1.00	0.00
	7	-0.00	0.00
	8	0.00	0.00
	9	4.65	0.00
	10	4.91	3.77
	11	4.91	5.29
	12	5.91	5.29
Top of Layer 3	13	-1.00	0.00
	14	-0.00	0.00
	15	0.00	0.00

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TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

#	X	Y1	Y2	Y3
1	-1.00	0.00	0.00	0.00
2	-0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.26	3.77	0.00	0.00
5	4.34	5.29	0.00	0.00
6	4.65	5.29	0.00	0.00
7	4.91	5.29	3.77	0.00
8	4.91	5.29	5.29	0.00
9	5.91	5.29	5.29	0.00

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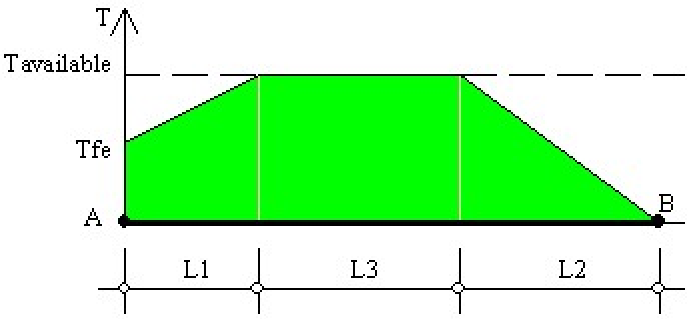
DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER



A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [m]	L [m]	L1 [m]	L2 [m]	L3 [m]	Tfe [kN/m]	Tavailable [kN/m]
1	---RW-95	0.22	4.65	0.00	0.74	3.91	33.63	33.63
2	---RW-95	0.66	4.41	0.00	0.83	3.58	33.63	33.63
3	---RW-95	1.10	3.87	0.00	0.97	2.90	33.63	33.63
4	---RW-95	1.54	3.00	0.00	1.22	1.78	33.63	33.63
5	---RW-95	1.98	3.00	0.00	1.44	1.56	33.63	33.63
6	---RW-95	2.42	3.00	0.00	1.77	1.23	33.63	33.63
7	---RW-95	2.86	3.00	0.00	2.39	0.61	33.63	33.63
8	---RW-95	3.30	3.00	0.00	3.00	0.00	27.46	27.46 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength.

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RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [m]		Exit Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	3.90	5.13	-6.68	0.06	-2.65	5.24	6.56	2.57	
2	4.72	5.29	-6.01	0.05	-1.93	5.32	6.66	1.97	
3	5.54	5.29	-4.71	0.06	-0.98	5.40	6.52	1.64	
4	6.36	5.29	-4.63	0.00	-0.44	5.36	6.80	1.48	
5	7.18	5.29	-4.69	0.05	-0.24	6.03	7.46	1.39	
6	8.00	5.29	-4.63	0.00	-0.18	7.11	8.38	1.33	
. 7	8.82	5.29	-4.71	0.05	-0.16	8.39	9.50	1.31 .	OK
8	9.64	5.29	-5.38	0.05	-0.51	10.23	11.29	1.31	
9	10.46	5.29	-6.03	0.04	-0.91	12.46	13.44	1.33	
10	11.28	5.29	-6.73	0.05	-1.24	14.74	15.68	1.38	
11	12.10	5.29	-6.05	0.04	-0.94	16.35	17.10	1.43	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points).

Exit Point #	Exit Point (X, Y) [m]		Entry Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	-6.73	0.06	9.64	5.29	-1.21	11.04	12.28	1.33	
2	-5.94	0.00	9.64	5.29	-0.82	10.50	11.69	1.32	
3	-5.30	0.01	8.82	5.29	-0.48	8.65	9.89	1.31	
. 4	-4.71	0.05	8.82	5.29	-0.16	8.39	9.50	1.31 .	OK
5	-4.09	0.07	8.82	5.29	0.17	8.11	9.10	1.32	
6	-3.31	0.00	8.82	5.29	0.43	7.99	8.82	1.34	
7	-2.65	0.00	8.82	5.29	0.77	7.67	8.39	1.37	
8	-2.06	0.03	9.64	5.29	1.04	8.77	9.28	1.42	
9	-1.35	0.01	9.64	5.29	1.40	8.37	8.80	1.48	
10	-0.74	0.02	9.64	5.29	1.67	8.13	8.46	1.54	
11	-0.00	0.00	9.64	5.29	0.86	9.86	9.90	1.62	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

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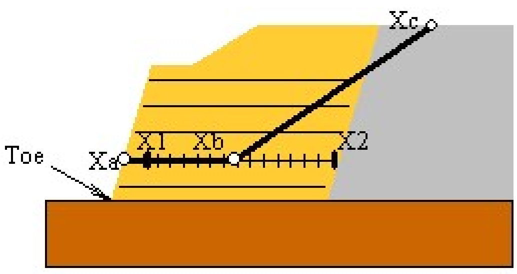
RESULTS OF TRANSLATIONAL ANALYSIS



Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [m]	(Xa, Ya) [m]		(Xb, Yb) [m]		(Xc, Yc) [m]		Fs	STATUS
At toe elevation	0.00	0.00	0.00	0.20	0.00	8.04	5.29	1.38	Minimum on Edge
Reinf. Layer #1	0.22	0.02	0.22	4.69	0.22	10.32	5.29	1.41	Minimum on Edge
Reinf. Layer #2	0.66	0.05	0.66	4.39	0.66	10.11	5.29	1.42	Minimum on Edge
Reinf. Layer #3	1.10	0.08	1.10	3.99	1.10	8.98	5.29	1.40	Minimum on Edge
. Reinf. Layer #4	1.54	0.11	1.54	3.09	1.54	7.72	5.29	1.34	Minimum on Edge
Reinf. Layer #5	1.98	0.14	1.98	3.09	1.98	7.65	5.29	1.39	Minimum on Edge
Reinf. Layer #6	2.42	0.17	2.42	3.19	2.42	7.00	5.29	1.43	Minimum on Edge
Reinf. Layer #7	2.86	0.20	2.86	3.19	2.86	6.53	5.29	1.48	Minimum on Edge
Reinf. Layer #8	3.30	0.23	3.30	3.19	3.30	5.83	5.29	1.53	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

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CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.31

Critical Circle: Xc = -0.16[m], Yc = 8.39[m], R = 9.50[m]. (Number of slices used = 57)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

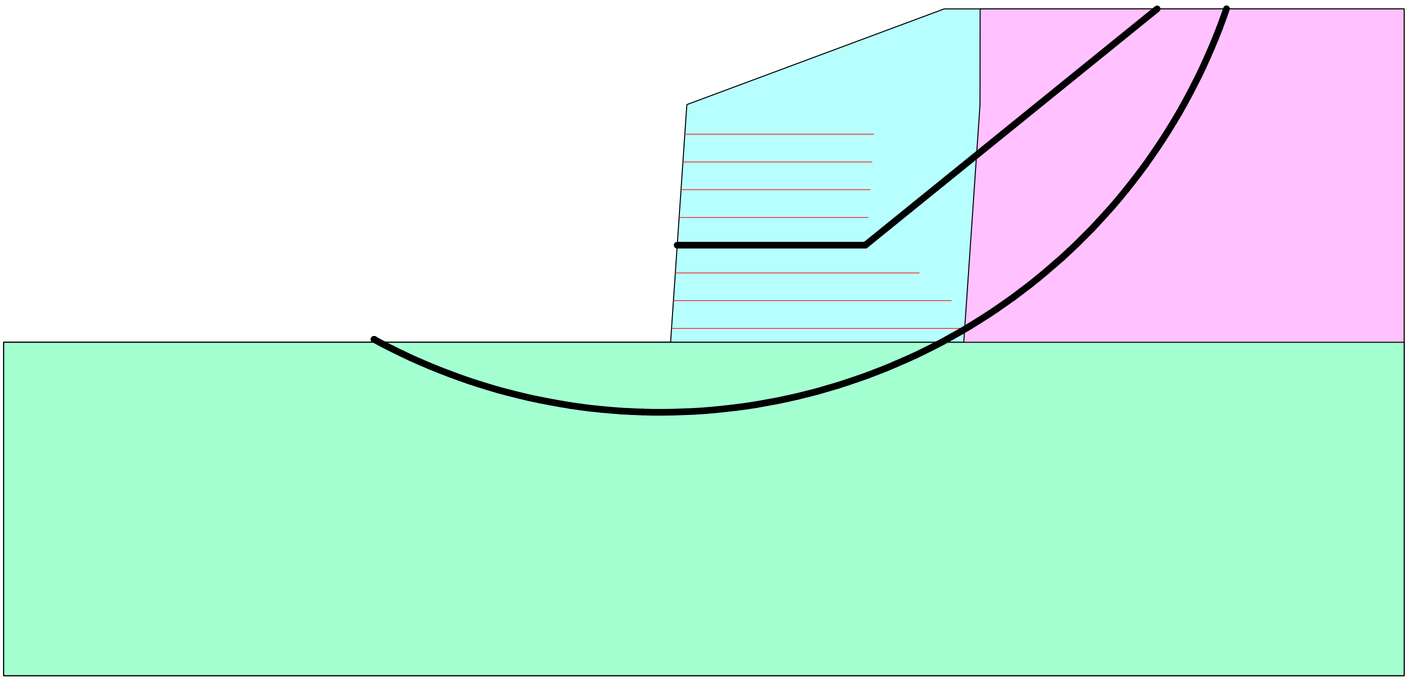
Minimum Factor of Safety = 1.34

Critical Two-Part Wedge: (Xa = 0.11, Ya = 1.54) [m]
(Xb = 3.09, Yb = 1.54) [m]
(Xc = 7.72, Yc = 5.29) [m]
(Number of slices used = 30)
Interslice resultant force inclination = 25.46 [degrees]

Three-Part Wedge Stability Analysis

N O T C O N D U C T E D

REINFORCEMENT LAYOUT: DRAWING



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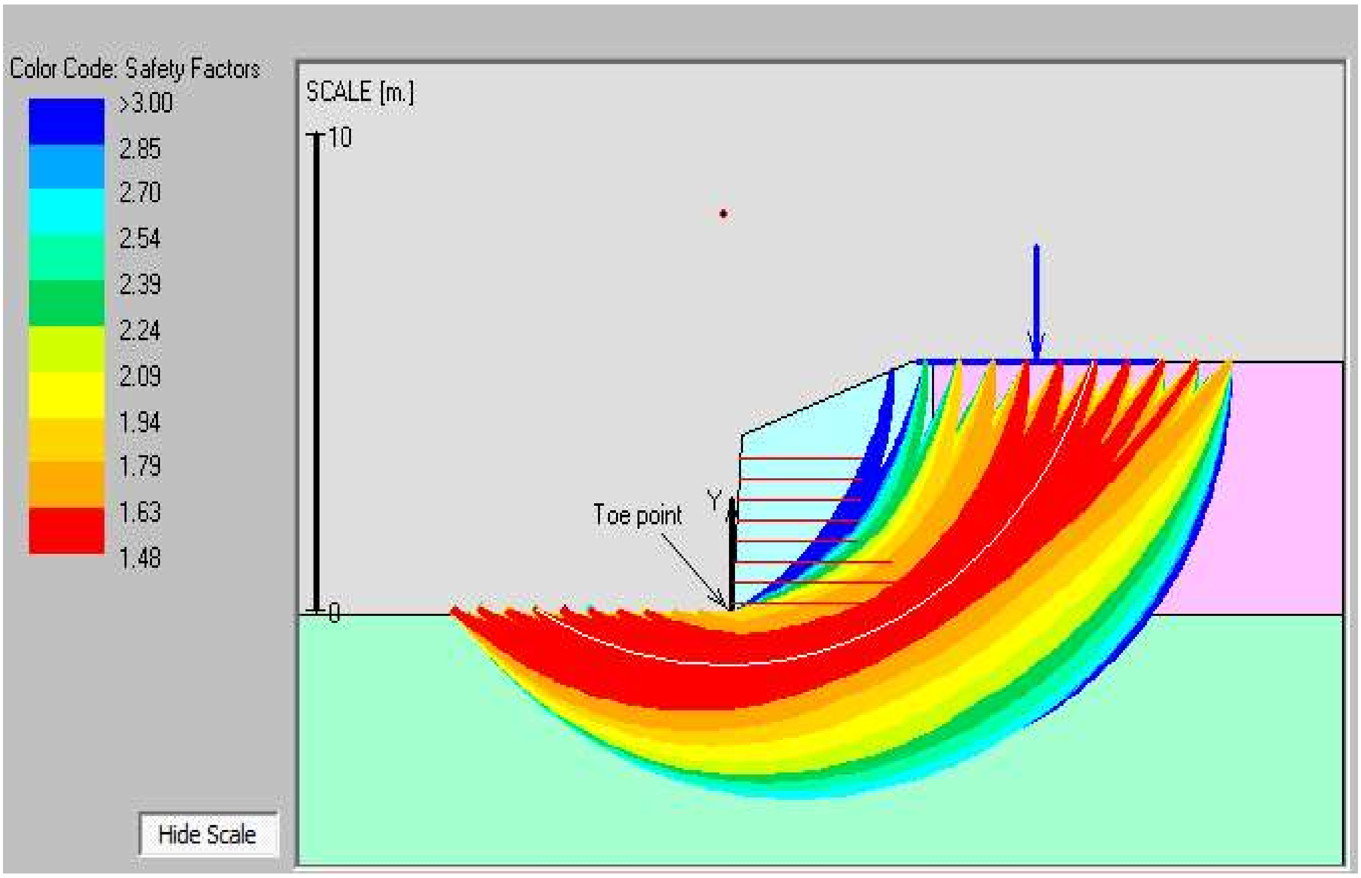
SAFETY MAP: BISHOP ROTATIONAL ANALYSIS MODE



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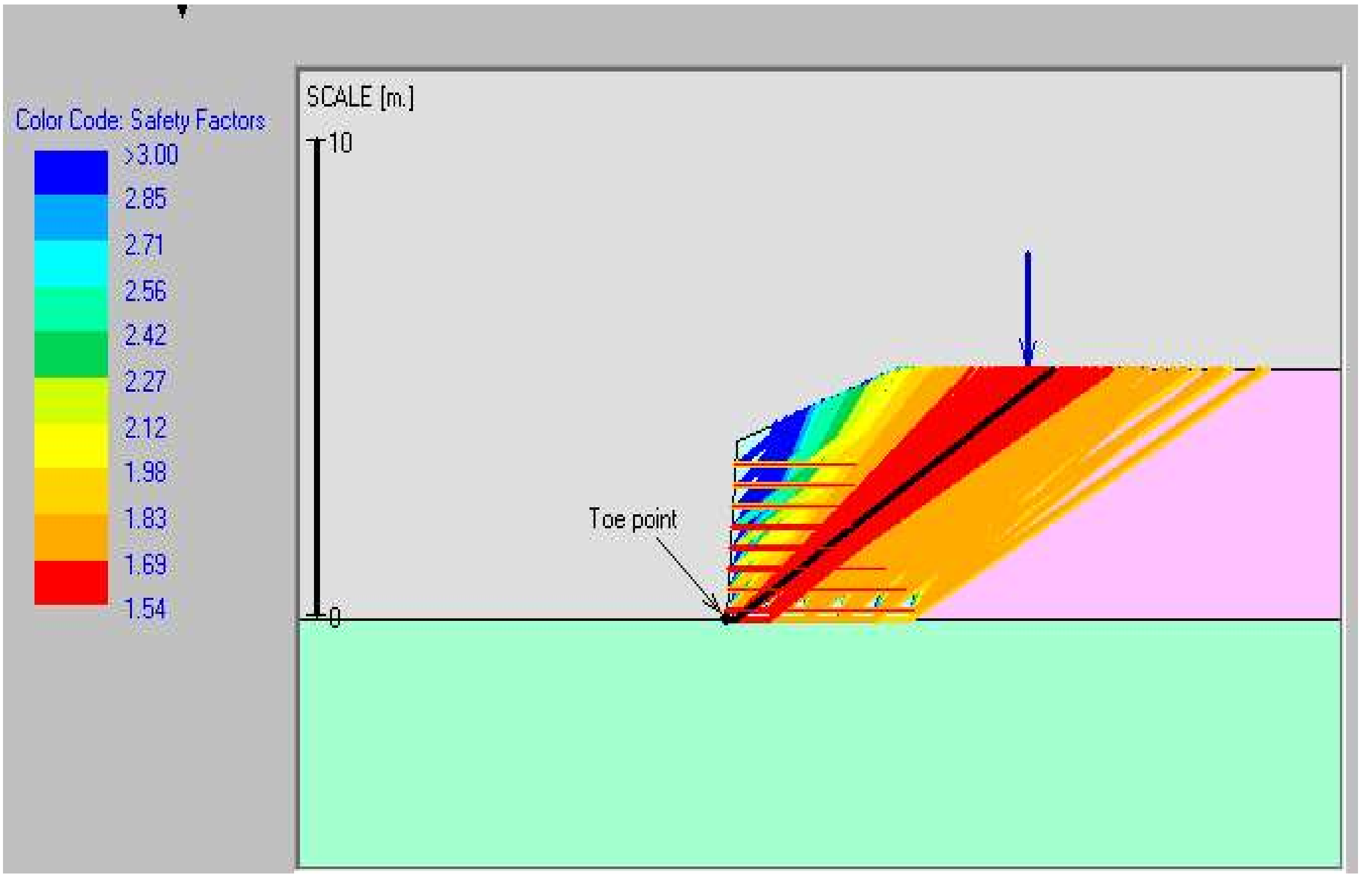
SAFETY MAP: SPENCER TRANSLATIONAL, 2-PART WEDGE



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AASHTO 2007 (LRFD)
km77+225（Combination A）

PROJECT IDENTIFICATION

Title: km77+225（Combination A）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+225（Combination A）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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SOIL DATA

REINFORCED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 33.0 °

RETAINED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)
Equivalent unit weight, $\gamma_{equiv.}$ 18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$ 31.0 °
Equivalent cohesion, $c_{equiv.}$ 0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3347 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 32.67 N γ= 25.99

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3198 Kae (Kh = 0) = 0.3080 Δ Kae = 0.0118 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

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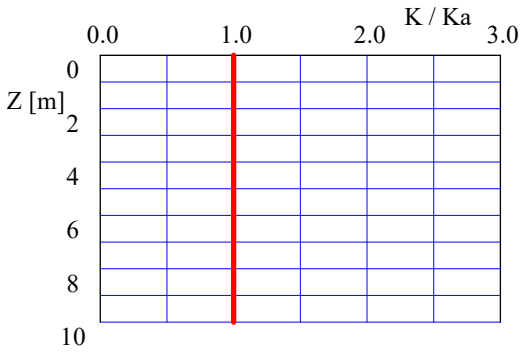
INPUT DATA: Geogrids (Analysis)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	N/A	N/A			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 3.99 [m] { Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 3.99 m }

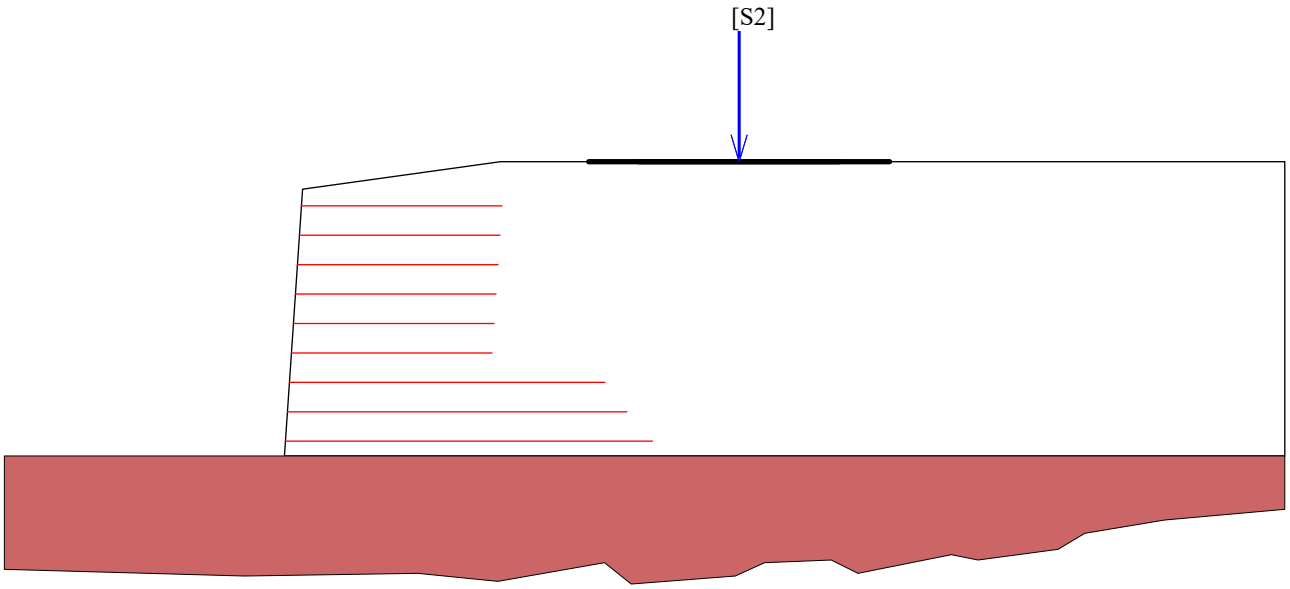
Batter, ω 3.9 [deg]
Backslope, β 7.9 [deg]
Backslope rise 0.4 [m]

Broken back equivalent angle, I = 2.94°(see Fig. 25 in DEMO 82)

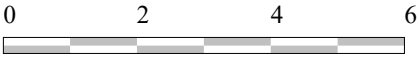
U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 12.5 and Qv-l = 0.0 [kPa].
Footing width, b=4.5 [m]. Distance of center of footing from wall face, d = 6.5 [m] @ depth of 0.0 [m] below soil surface.
[S2] Strip Load, Qv-d = 0.0 and Qv-l = 52.0 [kPa].
Footing width, b=3.0 [m]. Distance of center of footing from wall face, d = 6.5 [m] @ depth of 0.0 [m] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.50		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.50		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.77		0.90

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.50	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.50	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.50

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	0.83		0.90
Reinforced Soil and Reinforcement	ϕ_τ	0.77		0.90

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
	ϕ_b	0.74		0.90

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ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 5.78, Meyerhof stress = 148.03 kPa.

Foundation Interface: Direct sliding, CDR = 1.692, Eccentricity, e/L = 0.0773, CDR-overturning = 4.77

GEOGRID #	Elevation [m]	Length [m]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	5.49	1	N/A	N/A	N/A	2.013	15.693	1.332	0.0702	---RW-95
2	0.66	5.08	1	N/A	N/A	N/A	2.264	14.086	1.355	0.0597	---RW-95
3	1.10	4.72	1	N/A	N/A	N/A	2.587	12.511	1.516	0.0382	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	3.018	6.319	2.189	0.0254	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	3.621	5.805	2.561	0.0104	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	4.524	5.303	3.079	-0.0033	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	6.028	4.833	3.846	-0.0170	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	9.030	4.447	5.081	-0.0346	---RW-95
9	3.74	3.00	1	N/A	N/A	N/A	17.429	4.239	7.237	-0.0742	---RW-95

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, CDR = 8.93, Meyerhof stress = 108.72 kPa.

Foundation Interface: Direct sliding, CDR = 1.415, Eccentricity, e/L = 0.1133, Fs-overturning = 3.53

GEOGRID #	Elevation [m]	Length [m]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	5.49	1	N/A	N/A	N/A	1.943	13.591	1.196	0.1038	---RW-95
2	0.66	5.08	1	N/A	N/A	N/A	2.186	12.203	1.215	0.0892	---RW-95
3	1.10	4.72	1	N/A	N/A	N/A	2.498	10.834	1.370	0.0589	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	2.951	5.626	2.357	0.0321	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	3.534	5.146	2.771	0.0148	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	4.402	4.671	3.353	-0.0007	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	5.837	4.212	4.230	-0.0157	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	8.660	3.797	5.678	-0.0342	---RW-95
9	3.74	3.00	1	N/A	N/A	N/A	16.283	3.427	8.319	-0.0741	---RW-95

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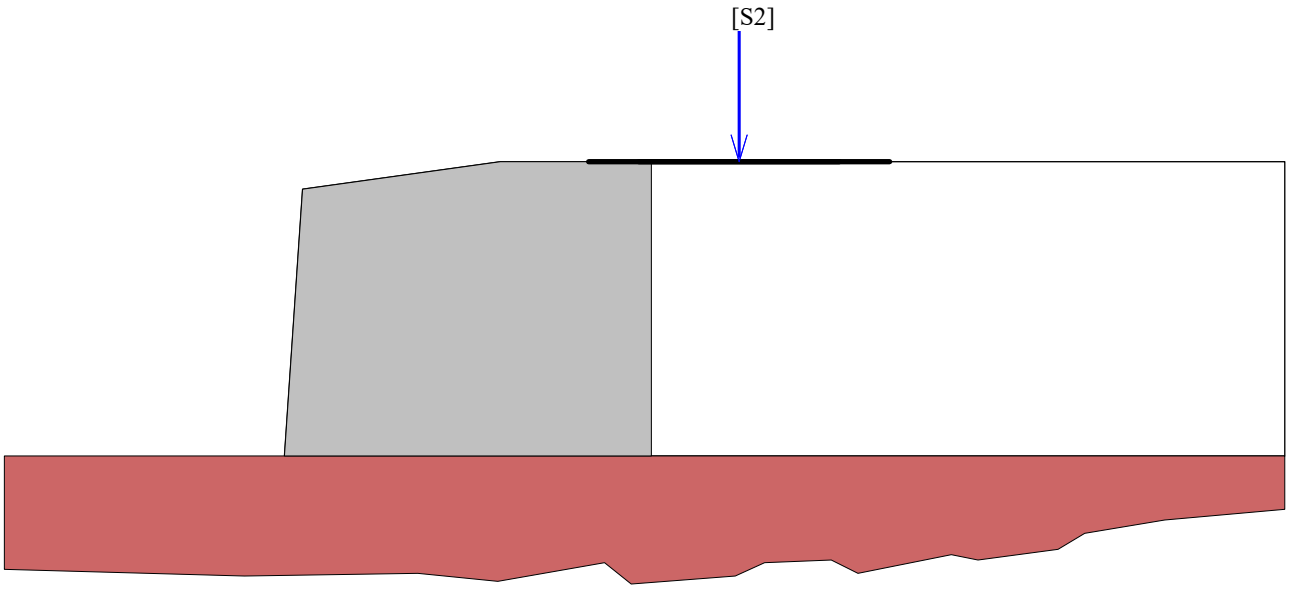
BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	856.3	970.6	[kPa]
Meyerhof stress, σ_V	148.03	108.7	[kPa]
Eccentricity, e	0.34	0.50	[m]
Eccentricity, e/L	0.062	0.092	
CDR calculated	5.78	8.93	
Base length	5.49	5.49	[m]



SCALE:

0 2 4 6 [m]

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DIRECT SLIDING for GIVEN LAYOUT (for GEOGRID reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.692 and CDR-seismic = 1.415

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	5.49	1.332	1.196	1	---RW-95
2	0.66	5.08	1.355	1.215	1	---RW-95
3	1.10	4.72	1.516	1.370	1	---RW-95
4	1.54	3.00	2.189	2.357	1	---RW-95
5	1.98	3.00	2.561	2.771	1	---RW-95
6	2.42	3.00	3.079	3.353	1	---RW-95
7	2.86	3.00	3.846	4.230	1	---RW-95
8	3.30	3.00	5.081	5.678	1	---RW-95
9	3.74	3.00	7.237	8.319	1	---RW-95

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = 0.0773, e/L seismic = 0.1133; Overturning: CDR-static = 4.77, CDR-seismic = 3.53

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	5.49	0.0702	0.1038	1	---RW-95
2	0.66	5.08	0.0597	0.0892	1	---RW-95
3	1.10	4.72	0.0382	0.0589	1	---RW-95
4	1.54	3.00	0.0254	0.0321	1	---RW-95
5	1.98	3.00	0.0104	0.0148	1	---RW-95
6	2.42	3.00	-0.0033	-0.0007	1	---RW-95
7	2.86	3.00	-0.0170	-0.0157	1	---RW-95
8	3.30	3.00	-0.0346	-0.0342	1	---RW-95
9	3.74	3.00	-0.0742	-0.0741	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	15.04	1.20	N/A	2.013	N/A	1.943	---RW-95
2	0.66	30.3	13.37	1.06	N/A	2.264	N/A	2.186	---RW-95
3	1.10	30.3	11.70	0.93	N/A	2.587	N/A	2.498	---RW-95
4	1.54	30.3	10.03	0.50	N/A	3.018	N/A	2.951	---RW-95
5	1.98	30.3	8.36	0.46	N/A	3.621	N/A	3.534	---RW-95
6	2.42	30.3	6.69	0.41	N/A	4.524	N/A	4.402	---RW-95
7	2.86	30.3	5.02	0.37	N/A	6.028	N/A	5.837	---RW-95
8	3.30	30.3	3.35	0.32	N/A	9.030	N/A	8.660	---RW-95
9	3.74	30.3	1.74	0.27	N/A	17.429	N/A	16.283	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	15.04	1.20	5.39	0.10	236.0	N/A	15.693	220.7	N/A	13.591
2	0.66	1.000	13.37	1.06	4.77	0.31	188.3	N/A	14.086	176.1	N/A	12.203
3	1.10	1.000	11.70	0.93	4.20	0.52	146.4	N/A	12.511	136.9	N/A	10.834
4	1.54	1.000	10.03	0.50	2.27	0.73	63.4	N/A	6.319	59.3	N/A	5.626
5	1.98	1.000	8.36	0.46	2.06	0.94	48.5	N/A	5.805	45.4	N/A	5.146
6	2.42	1.000	6.69	0.41	1.85	1.15	35.5	N/A	5.303	33.2	N/A	4.671
7	2.86	1.000	5.02	0.37	1.64	1.36	24.3	N/A	4.833	22.7	N/A	4.212
8	3.30	1.000	3.35	0.32	1.43	1.57	14.9	N/A	4.447	13.9	N/A	3.797
9	3.74	1.000	1.74	0.27	1.22	1.78	7.4	N/A	4.239	6.9	N/A	3.427

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AASHTO 2007 (LRFD)
km77+225（Combination B）

PROJECT IDENTIFICATION

Title: km77+225（Combination B）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+225（Combination B）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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SOIL DATA

REINFORCED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 33.0 °

RETAINED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)
Equivalent unit weight, $\gamma_{equiv.}$ 18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$ 31.0 °
Equivalent cohesion, $c_{equiv.}$ 0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)

Inclination of internal slip plane, $\Psi = 61.50°$ (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3347 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 32.67 N γ= 25.99

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3198 Kae (Kh = 0) = 0.3080 Δ Kae = 0.0118 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

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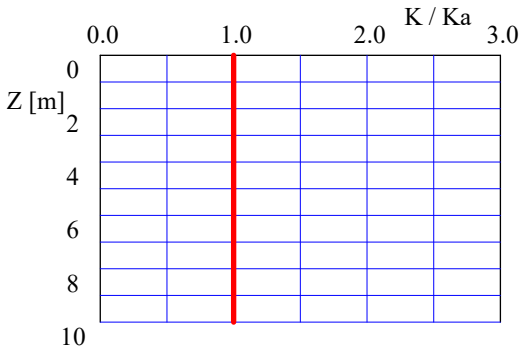
INPUT DATA: Geogrids (Analysis)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	N/A	N/A			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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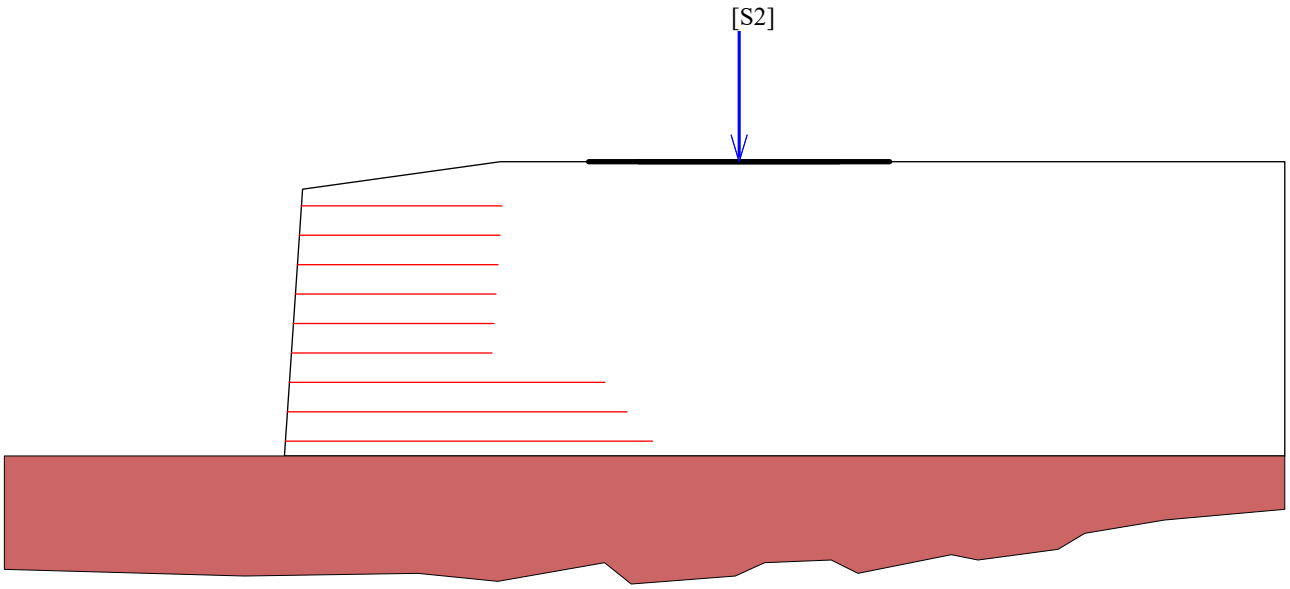
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	3.99	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 3.99 m }
Batter, ω	3.9	[deg]	
Backslope, β	7.9	[deg]	
Backslope rise	0.4	[m]	Broken back equivalent angle, I = 2.94° (see Fig. 25 in DEMO 82)

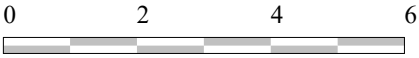
U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 12.5 and Qv-l = 0.0 [kPa].
Footing width, b=4.5 [m]. Distance of center of footing from wall face, d = 6.5 [m] @ depth of 0.0 [m] below soil surface.
[S2] Strip Load, Qv-d = 0.0 and Qv-l = 52.0 [kPa].
Footing width, b=3.0 [m]. Distance of center of footing from wall face, d = 6.5 [m] @ depth of 0.0 [m] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.00
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.00

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	0.90

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	0.90

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.77	0.90

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static		Combined Static/Seismic
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic
Reinforced Soil and Foundation	ϕ_τ	0.83	0.90
Reinforced Soil and Reinforcement	ϕ_τ	0.77	0.90

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:	Static	Combined Static/Seismic
ϕ_b	0.74	0.90

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ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 8.04, Meyerhof stress = 102.72 kPa.
Foundation Interface: Direct sliding, CDR = 1.390, Eccentricity, e/L = 0.0892, CDR-overturning = 4.19

GEOGRID #	Elevation [m]	Length [m]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	5.49	1	N/A	N/A	N/A	3.019	23.540	1.101	0.0803	---RW-95
2	0.66	5.08	1	N/A	N/A	N/A	3.396	21.129	1.119	0.0700	---RW-95
3	1.10	4.72	1	N/A	N/A	N/A	3.881	18.767	1.230	0.0489	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	4.527	9.479	1.466	0.0509	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	5.431	8.707	1.714	0.0286	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	6.786	7.954	2.060	0.0088	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	9.042	7.249	2.571	-0.0097	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	13.544	6.670	3.394	-0.0309	---RW-95
9	3.74	3.00	1	N/A	N/A	N/A	26.143	6.359	4.831	-0.0728	---RW-95

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, CDR = 10.39, Meyerhof stress = 99.46 kPa.
Foundation Interface: Direct sliding, CDR = 1.797, Eccentricity, e/L = 0.0765, Fs-overturning = 4.70

GEOGRID #	Elevation [m]	Length [m]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	5.49	1	N/A	N/A	N/A	2.866	19.661	1.527	0.0689	---RW-95
2	0.66	5.08	1	N/A	N/A	N/A	3.224	17.655	1.552	0.0591	---RW-95
3	1.10	4.72	1	N/A	N/A	N/A	3.683	15.671	1.729	0.0389	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	4.379	8.241	2.421	0.0299	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	5.238	7.523	2.841	0.0134	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	6.516	6.809	3.431	-0.0015	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	8.620	6.111	4.315	-0.0162	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	12.730	5.458	5.762	-0.0343	---RW-95
9	3.74	3.00	1	N/A	N/A	N/A	23.647	4.813	8.365	-0.0742	---RW-95

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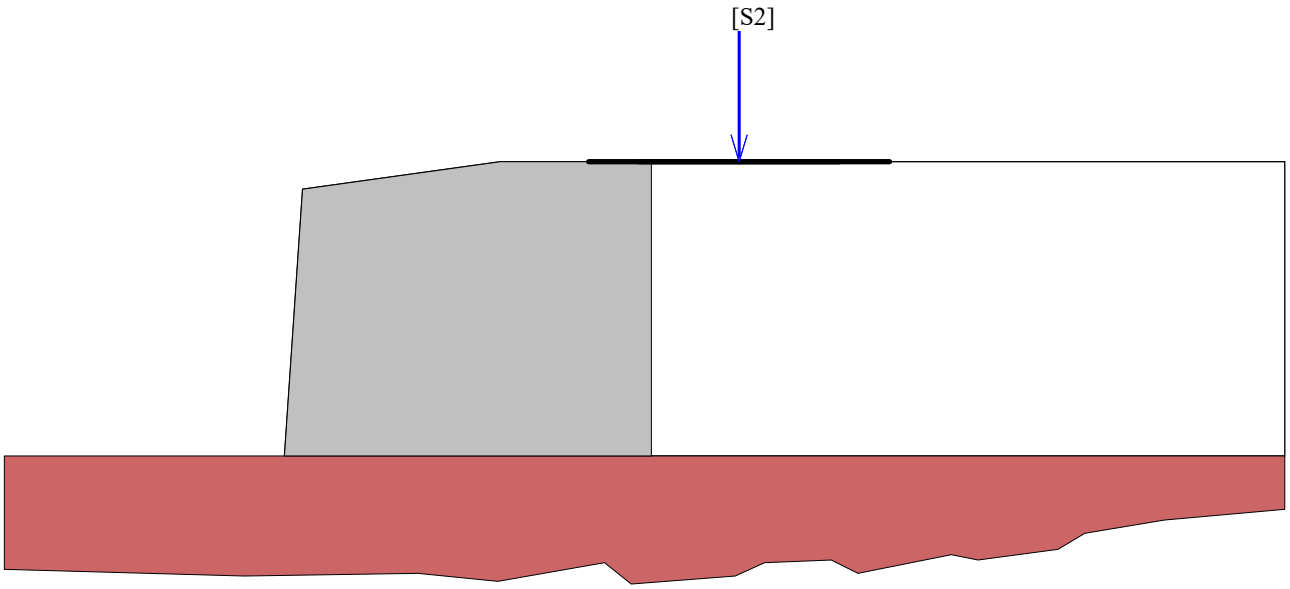
BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	825.5	1033.4	[kPa]
Meyerhof stress, σ_V	102.72	99.5	[kPa]
Eccentricity, e	0.43	0.36	[m]
Eccentricity, e/L	0.077	0.065	
CDR calculated	8.04	10.39	
Base length	5.49	5.49	[m]



SCALE:

0 2 4 6 [m]

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DIRECT SLIDING for GIVEN LAYOUT (for GEOGRID reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.390 and CDR-seismic = 1.797

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	5.49	1.101	1.527	1	---RW-95
2	0.66	5.08	1.119	1.552	1	---RW-95
3	1.10	4.72	1.230	1.729	1	---RW-95
4	1.54	3.00	1.466	2.421	1	---RW-95
5	1.98	3.00	1.714	2.841	1	---RW-95
6	2.42	3.00	2.060	3.431	1	---RW-95
7	2.86	3.00	2.571	4.315	1	---RW-95
8	3.30	3.00	3.394	5.762	1	---RW-95
9	3.74	3.00	4.831	8.365	1	---RW-95

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = 0.0892, e/L seismic = 0.0765; Overturning: CDR-static = 4.19, CDR-seismic = 4.70

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	5.49	0.0803	0.0689	1	---RW-95
2	0.66	5.08	0.0700	0.0591	1	---RW-95
3	1.10	4.72	0.0489	0.0389	1	---RW-95
4	1.54	3.00	0.0509	0.0299	1	---RW-95
5	1.98	3.00	0.0286	0.0134	1	---RW-95
6	2.42	3.00	0.0088	-0.0015	1	---RW-95
7	2.86	3.00	-0.0097	-0.0162	1	---RW-95
8	3.30	3.00	-0.0309	-0.0343	1	---RW-95
9	3.74	3.00	-0.0728	-0.0742	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	10.03	1.20	N/A	3.019	N/A	2.866	---RW-95
2	0.66	30.3	8.91	1.06	N/A	3.396	N/A	3.224	---RW-95
3	1.10	30.3	7.80	0.93	N/A	3.881	N/A	3.683	---RW-95
4	1.54	30.3	6.69	0.50	N/A	4.527	N/A	4.379	---RW-95
5	1.98	30.3	5.57	0.46	N/A	5.431	N/A	5.238	---RW-95
6	2.42	30.3	4.46	0.41	N/A	6.786	N/A	6.516	---RW-95
7	2.86	30.3	3.35	0.37	N/A	9.042	N/A	8.620	---RW-95
8	3.30	30.3	2.23	0.32	N/A	13.544	N/A	12.730	---RW-95
9	3.74	30.3	1.16	0.27	N/A	26.143	N/A	23.647	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	10.03	1.20	5.39	0.10	236.0	N/A	23.540	220.7	N/A	19.661
2	0.66	1.000	8.91	1.06	4.77	0.31	188.3	N/A	21.129	176.1	N/A	17.655
3	1.10	1.000	7.80	0.93	4.20	0.52	146.4	N/A	18.767	136.9	N/A	15.671
4	1.54	1.000	6.69	0.50	2.27	0.73	63.4	N/A	9.479	59.3	N/A	8.241
5	1.98	1.000	5.57	0.46	2.06	0.94	48.5	N/A	8.707	45.4	N/A	7.523
6	2.42	1.000	4.46	0.41	1.85	1.15	35.5	N/A	7.954	33.2	N/A	6.809
7	2.86	1.000	3.35	0.37	1.64	1.36	24.3	N/A	7.249	22.7	N/A	6.111
8	3.30	1.000	2.23	0.32	1.43	1.57	14.9	N/A	6.670	13.9	N/A	5.458
9	3.74	1.000	1.16	0.27	1.22	1.78	7.4	N/A	6.359	6.9	N/A	4.813

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AASHTO 2007 (LRFD)
km77+225（Combination C）

PROJECT IDENTIFICATION

Title: km77+225（Combination C）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+225（Combination C）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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SOIL DATA

REINFORCED SOIL

Unit weight, γ	19.5 kN/m^3
Design value of internal angle of friction, ϕ	33.0 °

RETAINED SOIL

Unit weight, γ	19.5 kN/m^3
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	18.5 kN/m^3
Equivalent internal angle of friction, $\phi_{equiv.}$	31.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10°Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3347 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 32.67 N γ= 25.99

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3198 Kae (Kh = 0) = 0.3080 Δ Kae = 0.0118 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

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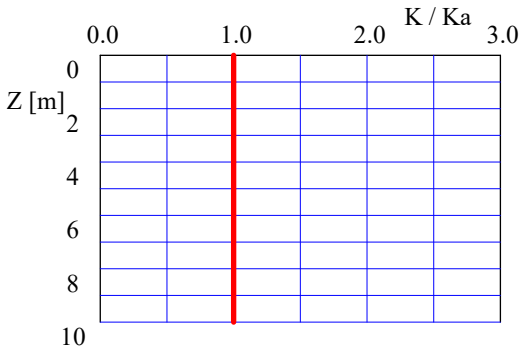
INPUT DATA: Geogrids (Analysis)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	N/A	N/A			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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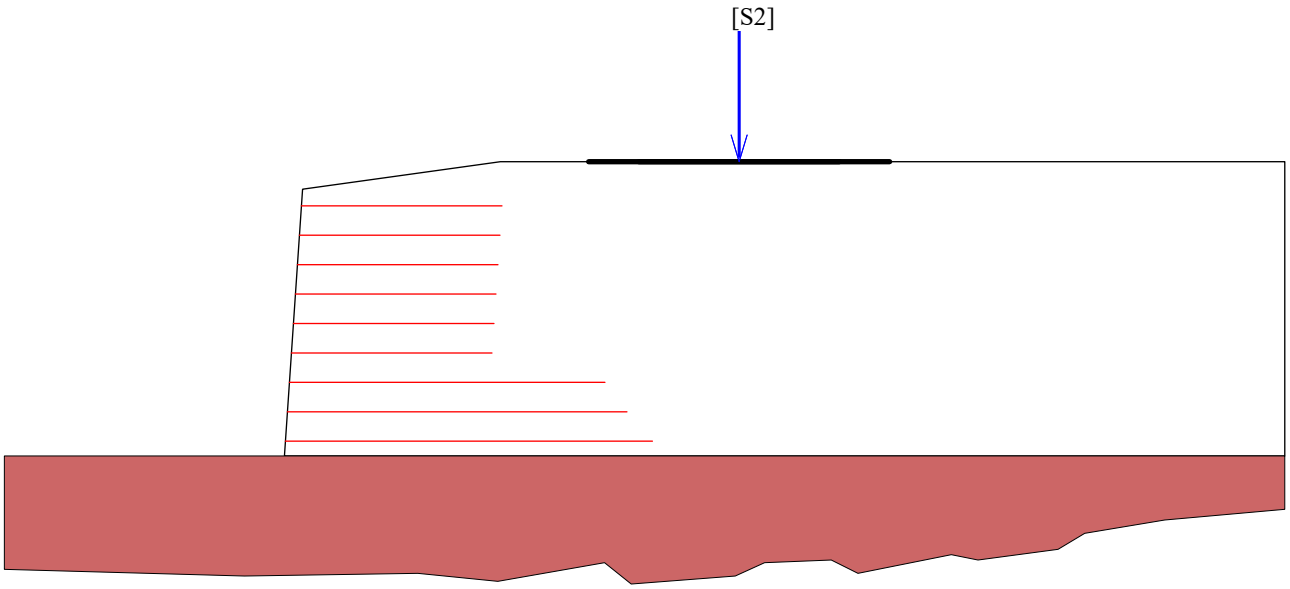
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	3.99	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 3.99 m }
Batter, ω	3.9	[deg]	
Backslope, β	7.9	[deg]	
Backslope rise	0.4	[m]	Broken back equivalent angle, I = 2.94° (see Fig. 25 in DEMO 82)

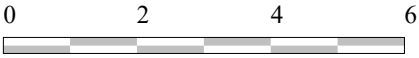
U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 12.5 and Qv-l = 0.0 [kPa].
Footing width, b=4.5 [m]. Distance of center of footing from wall face, d = 6.5 [m] @ depth of 0.0 [m] below soil surface.
[S2] Strip Load, Qv-d = 0.0 and Qv-l = 52.0 [kPa].
Footing width, b=3.0 [m]. Distance of center of footing from wall face, d = 6.5 [m] @ depth of 0.0 [m] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.00		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.00		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.00		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	1.00

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	1.00	1.00

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.00
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic
	ϕ_b	1.00	1.00

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ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 11.73, Meyerhof stress = 98.69 kPa.
Foundation Interface: Direct sliding, CDR = 2.056, Eccentricity, e/L = 0.0731, CDR-overturning = 4.84

GEOGRID				CONNECTION							
#	Elevation [m]	Length [m]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	5.49	1	N/A	N/A	N/A	3.019	30.571	1.745	0.0659	---RW-95
2	0.66	5.08	1	N/A	N/A	N/A	3.396	27.440	1.772	0.0563	---RW-95
3	1.10	4.72	1	N/A	N/A	N/A	3.881	24.372	1.976	0.0365	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	4.527	12.310	2.843	0.0254	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	5.431	11.308	3.327	0.0104	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	6.786	10.330	3.999	-0.0033	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	9.042	9.414	4.995	-0.0170	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	13.544	8.663	6.599	-0.0346	---RW-95
9	3.74	3.00	1	N/A	N/A	N/A	26.143	8.259	9.398	-0.0742	---RW-95

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, CDR = 11.54, Meyerhof stress = 99.46 kPa.
Foundation Interface: Direct sliding, CDR = 1.997, Eccentricity, e/L = 0.0765, Fs-overturning = 4.70

GEOGRID				CONNECTION							
#	Elevation [m]	Length [m]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	5.49	1	N/A	N/A	N/A	3.184	21.845	1.697	0.0689	---RW-95
2	0.66	5.08	1	N/A	N/A	N/A	3.582	19.617	1.725	0.0591	---RW-95
3	1.10	4.72	1	N/A	N/A	N/A	4.092	17.412	1.921	0.0389	---RW-95
4	1.54	3.00	1	N/A	N/A	N/A	4.865	9.156	2.690	0.0299	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	5.820	8.359	3.157	0.0134	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	7.240	7.565	3.813	-0.0015	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	9.577	6.790	4.794	-0.0162	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	14.144	6.065	6.403	-0.0343	---RW-95
9	3.74	3.00	1	N/A	N/A	N/A	26.275	5.348	9.294	-0.0742	---RW-95

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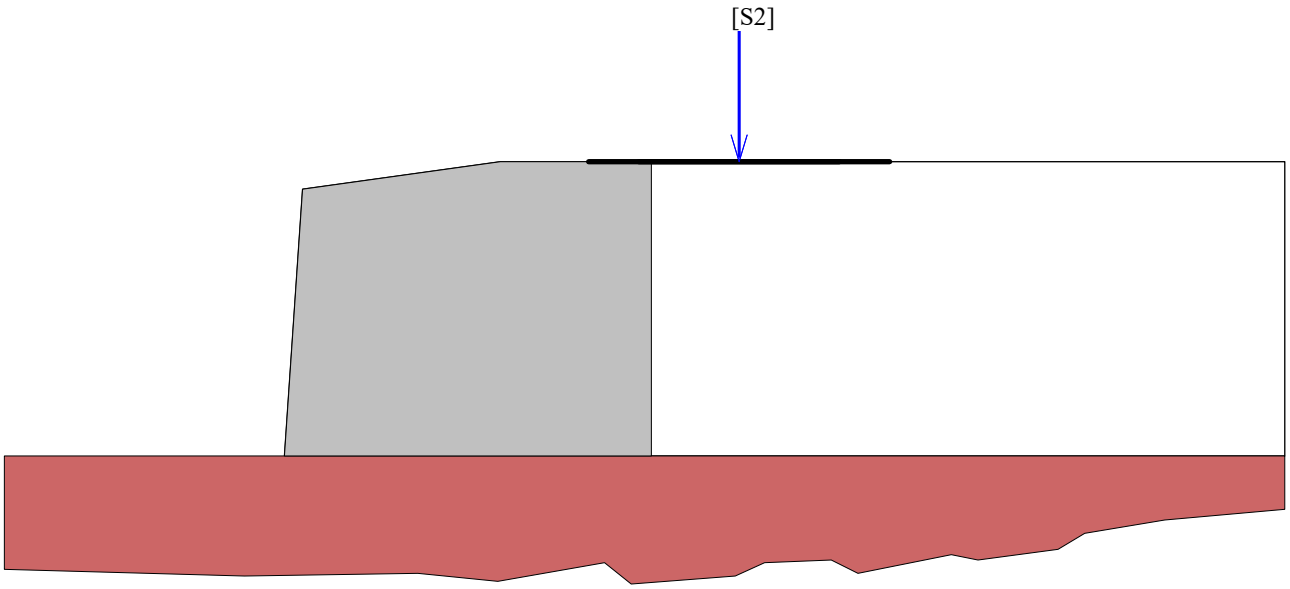
BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	1157.2	1148.3	[kPa]
Meyerhof stress, σ_V	98.69	99.5	[kPa]
Eccentricity, e	0.34	0.36	[m]
Eccentricity, e/L	0.062	0.065	
CDR calculated	11.73	11.54	
Base length	5.49	5.49	[m]



SCALE:

0 2 4 6 [m]

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DIRECT SLIDING for GIVEN LAYOUT (for GEOGRID reinforcements)

Along reinforced and foundation soils interface: CDR-static = 2.056 and CDR-seismic = 1.997

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	5.49	1.745	1.697	1	---RW-95
2	0.66	5.08	1.772	1.725	1	---RW-95
3	1.10	4.72	1.976	1.921	1	---RW-95
4	1.54	3.00	2.843	2.690	1	---RW-95
5	1.98	3.00	3.327	3.157	1	---RW-95
6	2.42	3.00	3.999	3.813	1	---RW-95
7	2.86	3.00	4.995	4.794	1	---RW-95
8	3.30	3.00	6.599	6.403	1	---RW-95
9	3.74	3.00	9.398	9.294	1	---RW-95

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = 0.0731, e/L seismic = 0.0765; Overturning: CDR-static = 4.84, CDR-seismic = 4.70

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	5.49	0.0659	0.0689	1	---RW-95
2	0.66	5.08	0.0563	0.0591	1	---RW-95
3	1.10	4.72	0.0365	0.0389	1	---RW-95
4	1.54	3.00	0.0254	0.0299	1	---RW-95
5	1.98	3.00	0.0104	0.0134	1	---RW-95
6	2.42	3.00	-0.0033	-0.0015	1	---RW-95
7	2.86	3.00	-0.0170	-0.0162	1	---RW-95
8	3.30	3.00	-0.0346	-0.0343	1	---RW-95
9	3.74	3.00	-0.0742	-0.0742	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	10.03	1.20	N/A	3.019	N/A	3.184	---RW-95
2	0.66	30.3	8.91	1.06	N/A	3.396	N/A	3.582	---RW-95
3	1.10	30.3	7.80	0.93	N/A	3.881	N/A	4.092	---RW-95
4	1.54	30.3	6.69	0.50	N/A	4.527	N/A	4.865	---RW-95
5	1.98	30.3	5.57	0.46	N/A	5.431	N/A	5.820	---RW-95
6	2.42	30.3	4.46	0.41	N/A	6.786	N/A	7.240	---RW-95
7	2.86	30.3	3.35	0.37	N/A	9.042	N/A	9.577	---RW-95
8	3.30	30.3	2.23	0.32	N/A	13.544	N/A	14.144	---RW-95
9	3.74	30.3	1.16	0.27	N/A	26.143	N/A	26.275	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	10.03	1.20	5.39	0.10	306.5	N/A	30.571	245.2	N/A	21.845
2	0.66	1.000	8.91	1.06	4.77	0.31	244.6	N/A	27.440	195.6	N/A	19.617
3	1.10	1.000	7.80	0.93	4.20	0.52	190.1	N/A	24.372	152.1	N/A	17.412
4	1.54	1.000	6.69	0.50	2.27	0.73	82.3	N/A	12.310	65.8	N/A	9.156
5	1.98	1.000	5.57	0.46	2.06	0.94	63.0	N/A	11.308	50.4	N/A	8.359
6	2.42	1.000	4.46	0.41	1.85	1.15	46.1	N/A	10.330	36.9	N/A	7.565
7	2.86	1.000	3.35	0.37	1.64	1.36	31.5	N/A	9.414	25.2	N/A	6.790
8	3.30	1.000	2.23	0.32	1.43	1.57	19.4	N/A	8.663	15.5	N/A	6.065
9	3.74	1.000	1.16	0.27	1.22	1.78	9.6	N/A	8.259	7.6	N/A	5.348

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77+225 overall stability(no seismicity)

Report created by ReSSA(3.0): Update #4.21: Copyright (c) 2001-2016, ADAMA Engineering, Inc.

PROJECT IDENTIFICATION

Title: 77+225 overall stability(no seismicity)
Project Number: -
Client:
Designer: 戴征杰（BOSTD）

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia
,
Telephone #:
Fax #:
E-Mail:

Original file path and name:
Original date and time of creating this file: Mon Apr 12 11:02:33 2021

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

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INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [kN/m^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [kPa]
1....... Reinforced Soil..................................	19.5	33.0	0.0
2....... Retained Soil......................................	19.5	30.0	0.0
3....... Foundation Soil.................................	18.5	31.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [kN/m]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Additional Reduction Factor, RFa	Coverage Ratio, Rc
1	---RW-95	95.70	1.16	1.10	2.23	1.00	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
1	---RW-95	0.77	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Not Applicable

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DRAWING OF SPECIFIED GEOMETRY - GENERAL - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

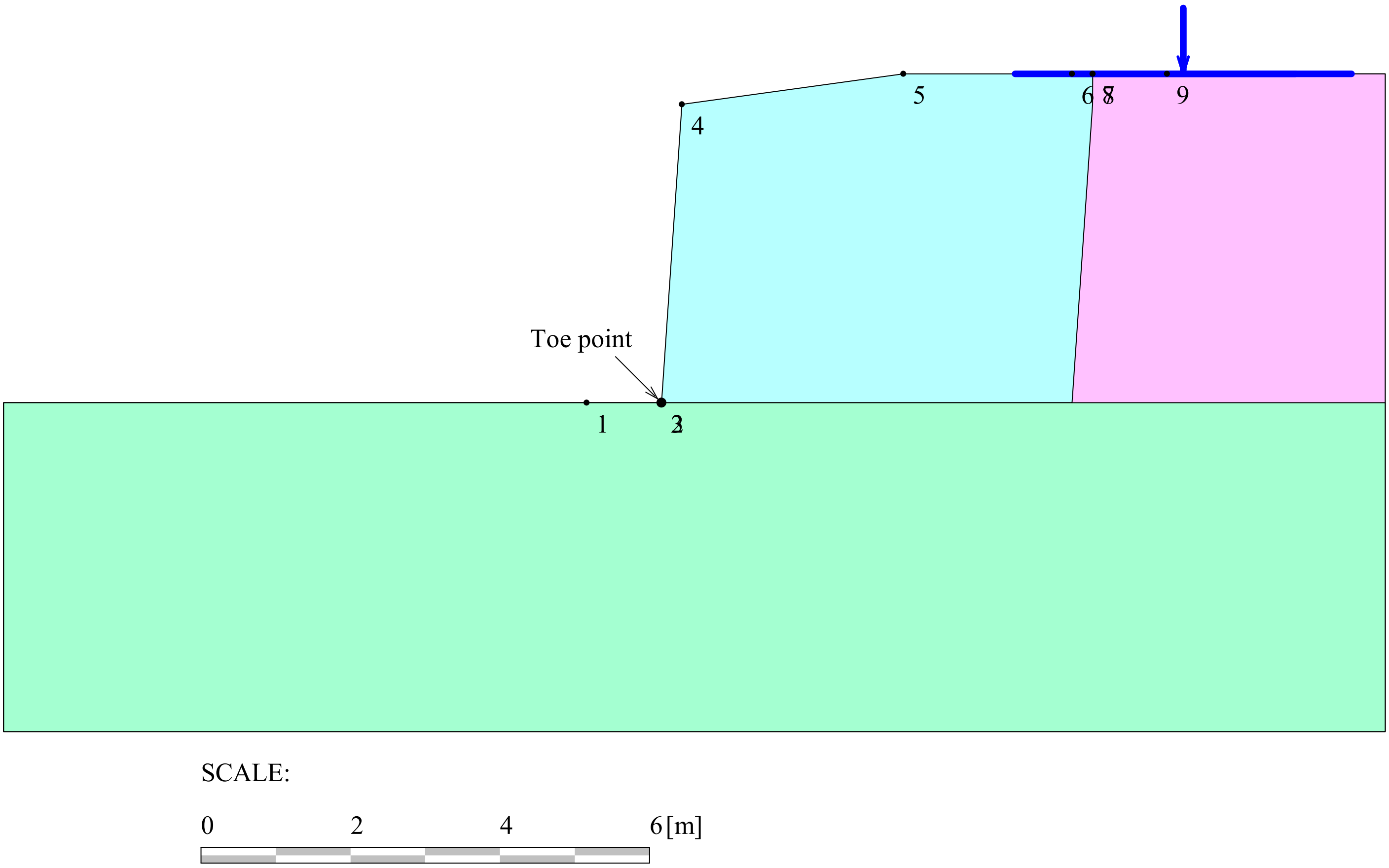
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Surcharge load, Q1 ....None
Surcharge load, Q2 ....None
Surcharge load, Q3 ....None

STRIP LOAD

Strip Load #1.. 12.50 [kPa] Width of base, b = 4.50 [m] Distance from toe point, d = 6.98 [m]
Strip Load #2.. 52.00 [kPa] Width of base, b = 3.00 [m] Distance from toe point, d = 6.98 [m]



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TABULATED DETAILS OF GEMERAL SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

	#	Xi	Yi
Top of Layer 1	1	-1.00	0.00
	2	-0.00	0.00
	3	0.00	0.00
	4	0.27	3.99
	5	3.23	4.40
Top of Layer 2	6	-1.00	0.00
	7	-0.00	0.00
	8	0.00	0.00
	9	5.49	0.00
	10	5.77	3.99
	11	5.77	4.40
	12	6.76	4.40
Top of Layer 3	13	-1.00	0.00
	14	-0.00	0.00
	15	0.00	0.00

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TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

#	X	Y1	Y2	Y3
1	-1.00	0.00	0.00	0.00
2	-0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.27	3.99	0.00	0.00
5	3.23	4.40	0.00	0.00
6	5.49	4.40	0.00	0.00
7	5.77	4.40	3.99	0.00
8	5.77	4.40	4.40	0.00
9	6.76	4.40	4.40	0.00

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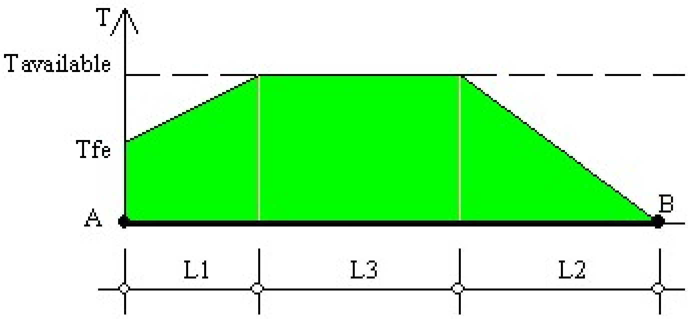
DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER



A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [m]	L [m]	L1 [m]	L2 [m]	L3 [m]	Tfe [kN/m]	Tavailable [kN/m]
1	---RW-95	0.22	5.49	0.00	0.89	4.60	33.63	33.63
2	---RW-95	0.66	5.08	0.00	1.00	4.08	33.63	33.63
3	---RW-95	1.10	4.72	0.00	1.13	3.59	33.63	33.63
4	---RW-95	1.54	3.00	0.00	1.36	1.64	33.63	33.63
5	---RW-95	1.98	3.00	0.00	1.63	1.37	33.63	33.63
6	---RW-95	2.42	3.00	0.00	2.04	0.96	33.63	33.63
7	---RW-95	2.86	3.00	0.00	2.77	0.23	33.63	33.63
8	---RW-95	3.30	3.00	0.00	3.00	0.00	24.00	24.00 (*)
9	---RW-95	3.74	3.00	0.00	3.00	0.00	12.32	12.32 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength.

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RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [m]		Exit Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	3.00	4.37	-5.86	0.04	-2.49	4.39	5.49	6.85	
2	3.90	4.40	-5.31	0.07	-1.74	4.45	5.65	2.80	
3	4.80	4.40	-5.32	0.09	-1.20	4.46	6.00	2.58	
4	5.70	4.40	-4.67	0.03	-0.45	4.50	6.15	2.16	
5	6.60	4.40	-4.72	0.06	-0.48	5.94	7.25	1.77	
6	7.50	4.40	-4.12	0.03	-0.01	6.74	7.87	1.59	
. 7	8.40	4.40	-4.69	0.03	0.14	7.36	8.78	1.50 .	OK
8	9.30	4.40	-4.75	0.06	0.24	8.81	10.07	1.54	
9	10.20	4.40	-5.93	0.06	-0.39	11.61	12.81	1.64	
10	11.10	4.40	-5.39	0.07	-0.08	13.40	14.35	1.79	
11	12.00	4.40	-5.92	0.04	-0.44	16.51	17.36	1.94	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points).

Exit Point #	Exit Point (X, Y) [m]		Entry Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	-5.81	0.00	8.40	4.40	-0.53	8.11	9.67	1.52	
2	-5.32	0.07	8.40	4.40	-0.13	7.54	9.09	1.51	
. 3	-4.69	0.03	8.40	4.40	0.14	7.36	8.78	1.50 .	OK
4	-4.17	0.07	8.40	4.40	0.42	7.16	8.45	1.50	
5	-3.51	0.02	8.40	4.40	0.70	6.96	8.11	1.51	
6	-2.95	0.03	8.40	4.40	0.99	6.73	7.77	1.54	
7	-2.37	0.03	8.40	4.40	1.28	6.49	7.42	1.57	
8	-1.76	0.01	8.40	4.40	1.01	7.55	8.04	1.63	
9	-1.24	0.03	8.40	4.40	1.24	7.38	7.76	1.68	
10	-0.66	0.02	8.40	4.40	1.48	7.17	7.46	1.75	
11	-0.00	0.00	8.40	4.40	1.64	7.09	7.28	1.83	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

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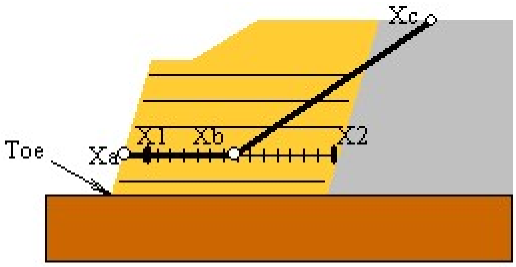
RESULTS OF TRANSLATIONAL ANALYSIS



Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [m]	(Xa, Ya) [m]		(Xb, Yb) [m]		(Xc, Yc) [m]		Fs	STATUS
At toe elevation	0.00	0.00	0.00	0.20	0.00	7.24	4.40	1.58	Minimum on Edge
Reinf. Layer #1	0.22	0.02	0.22	5.49	0.22	8.64	4.40	1.58	Minimum on Edge
Reinf. Layer #2	0.66	0.05	0.66	5.09	0.66	8.46	4.40	1.55	Minimum on Edge
. Reinf. Layer #3	1.10	0.08	1.10	4.79	1.10	8.46	4.40	1.55	Minimum on Edge
Reinf. Layer #4	1.54	0.11	1.54	3.09	1.54	7.17	4.40	1.63	Minimum on Edge
Reinf. Layer #5	1.98	0.14	1.98	3.09	1.98	7.12	4.40	1.75	Minimum on Edge
Reinf. Layer #6	2.42	0.17	2.42	3.19	2.42	6.62	4.40	1.91	Minimum on Edge
Reinf. Layer #7	2.86	0.20	2.86	3.19	2.86	5.86	4.40	2.33	Minimum on Edge
Reinf. Layer #8	3.30	0.23	3.30	3.19	3.30	5.10	4.40	3.33	Minimum on Edge
Reinf. Layer #9	3.74	0.26	3.74	1.56	3.74	2.43	4.29	6.62	OK

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

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CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.50

Critical Circle: Xc = 0.14[m], Yc = 7.36[m], R = 8.78[m]. (Number of slices used = 58)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

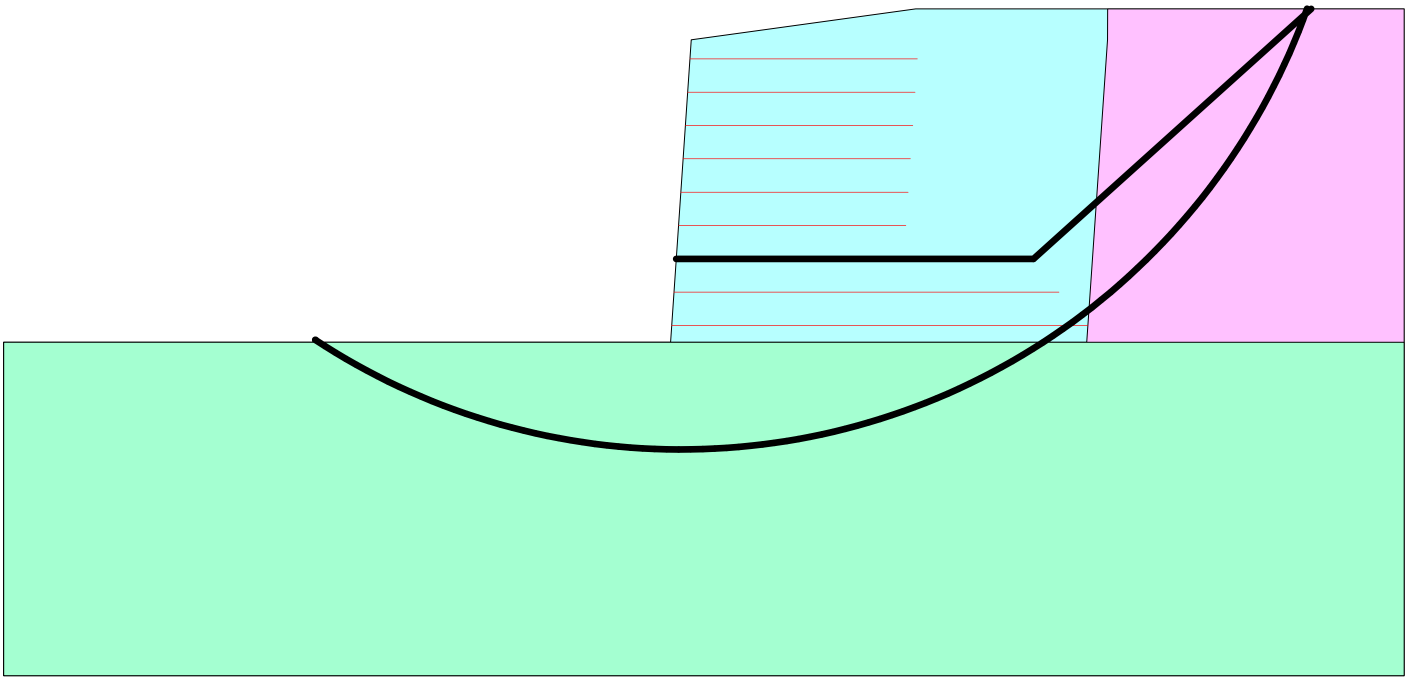
Minimum Factor of Safety = 1.55

Critical Two-Part Wedge: (Xa = 0.08, Ya = 1.10) [m]
(Xb = 4.79, Yb = 1.10) [m]
(Xc = 8.46, Yc = 4.40) [m]
(Number of slices used = 30)
Interslice resultant force inclination = 22.08 [degrees]

Three-Part Wedge Stability Analysis

N O T C O N D U C T E D

REINFORCEMENT LAYOUT: DRAWING



SCALE:

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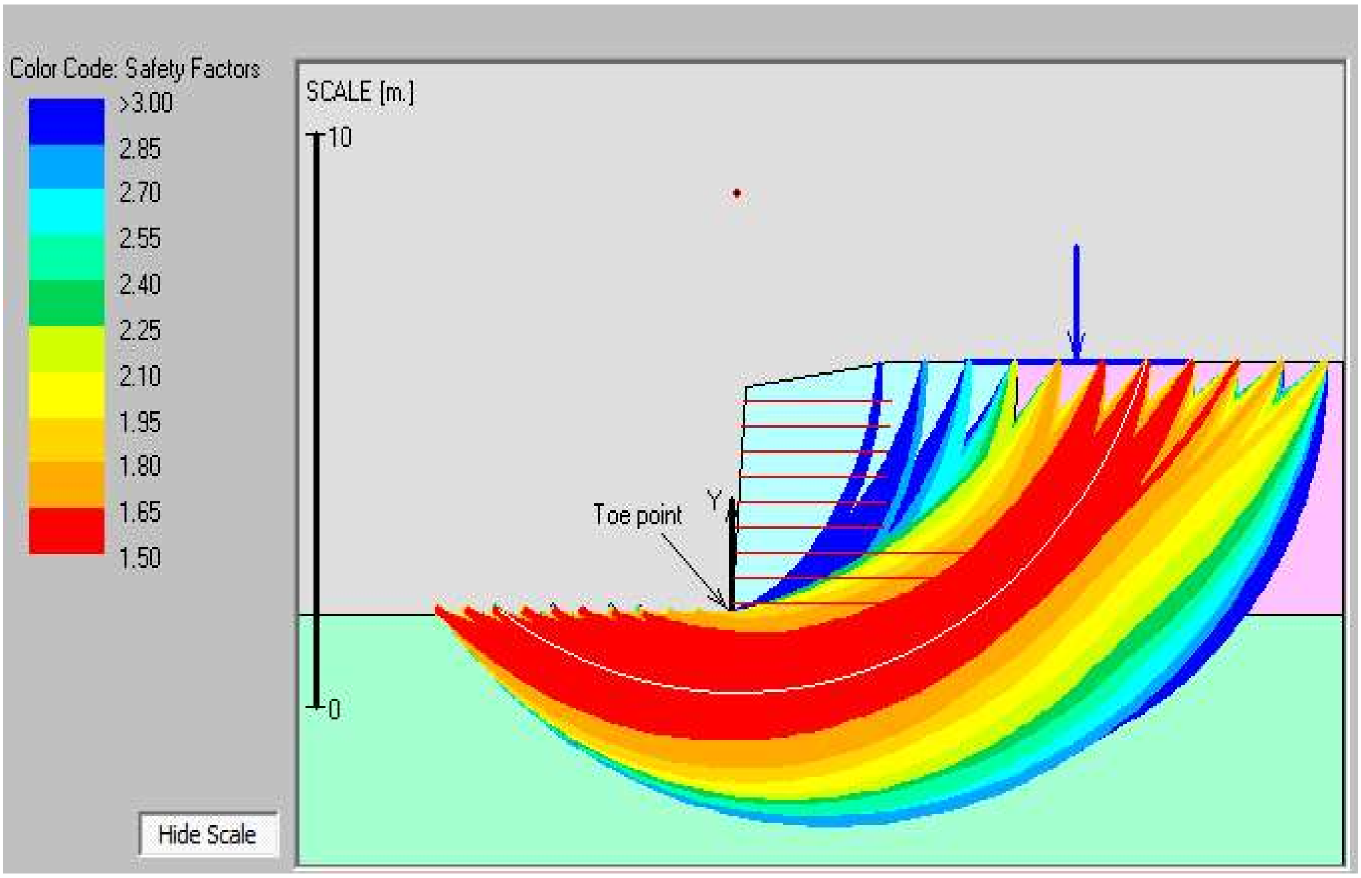
SAFETY MAP: BISHOP ROTATIONAL ANALYSIS MODE



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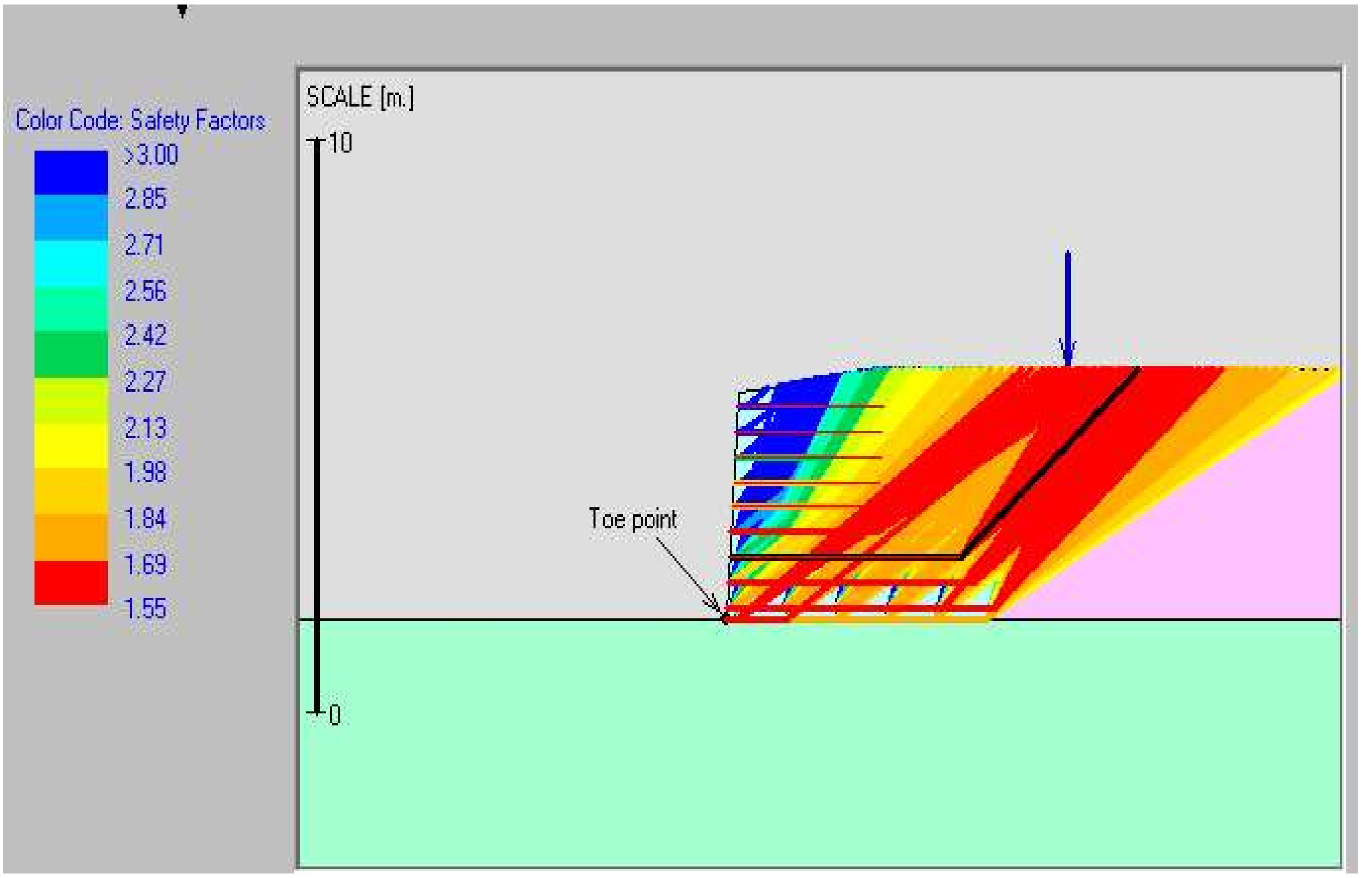
SAFETY MAP: SPENCER TRANSLATIONAL, 2-PART WEDGE



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Version 3.0 ReSSA Version 3.0

77+225 overall stability(seismicity)

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PROJECT IDENTIFICATION

Title: 77+225 overall stability(seismicity)
Project Number: -
Client:
Designer: 戴征杰（BOSTD）

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia
,
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+225 overall stability.MSE
Original date and time of creating this file: Mon Apr 12 11:02:33 2021

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

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INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [kN/m^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [kPa]
.1....... Reinforced Soil..................................	19.5	33.0	0.0
.2....... Retained Soil......................................	19.5	30.0	0.0
.3....... Foundation Soil.................................	18.5	31.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [kN/m]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Additional Reduction Factor, RFa	Coverage Ratio, Rc
1	---RW-95	95.70	1.16	1.10	2.23	1.00	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
1	---RW-95	0.77	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Horizontal peak ground acceleration coefficient, Ao = 0.140
Design horizontal seismic coefficient, kh = Am = 0.50 x Ao = 0.070 & design vertical seismic coefficient, kv (down) = 0.000 x kh = 0.000

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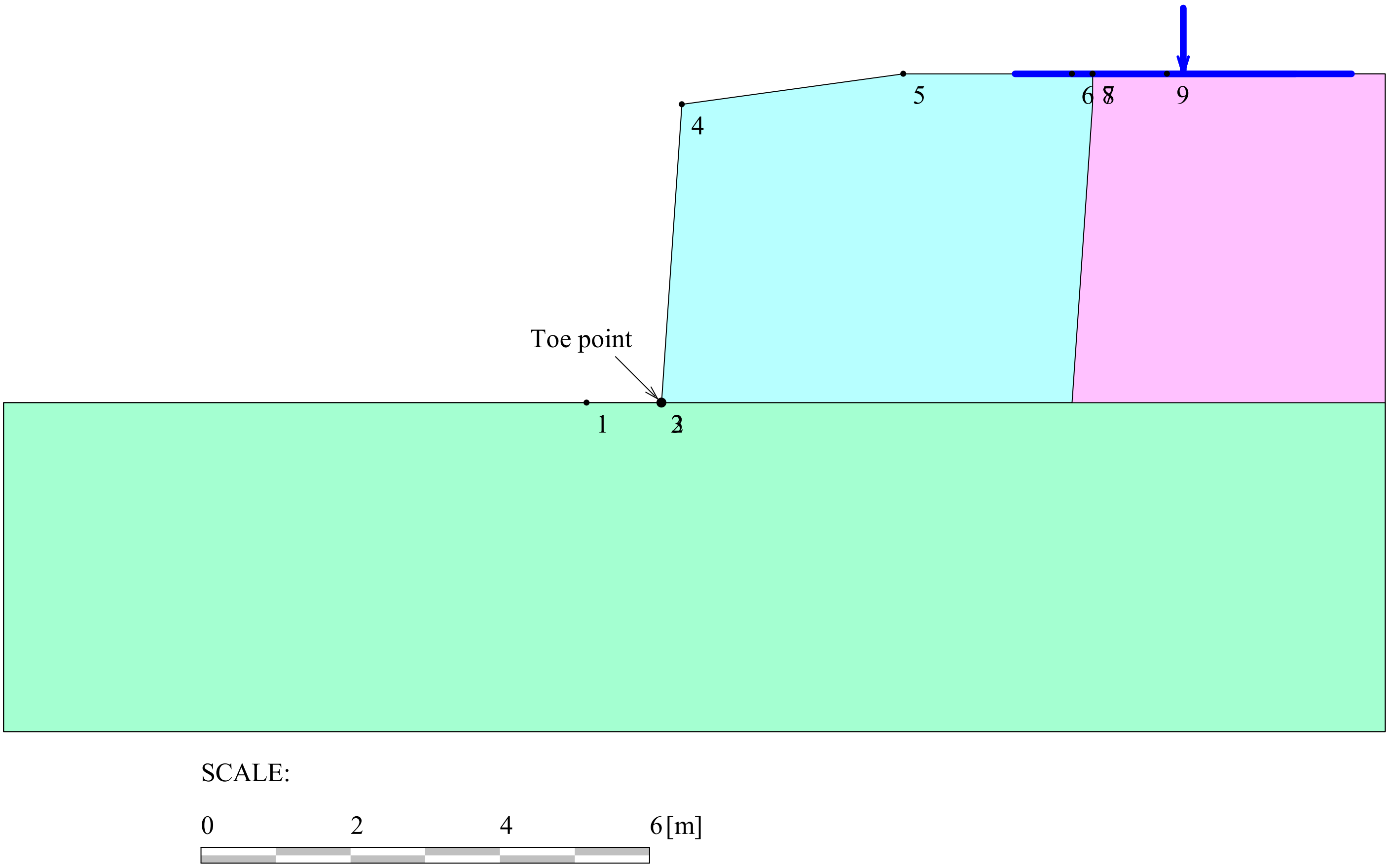
DRAWING OF SPECIFIED GEOMETRY - GENERAL - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE
Surcharge load, Q1....................................None
Surcharge load, Q2....................................None
Surcharge load, Q3....................................None

STRIP LOAD
Strip Load #1.. 12.50 [kPa] Width of base, b = 4.50 [m] Distance from toe point, d = 6.98 [m]
Strip Load #2.. 52.00 [kPa] Width of base, b = 3.00 [m] Distance from toe point, d = 6.98 [m]



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TABULATED DETAILS OF GEMERAL SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

	#	Xi	Yi
Top of Layer 1	1	-1.00	0.00
	2	-0.00	0.00
	3	0.00	0.00
	4	0.27	3.99
	5	3.23	4.40
Top of Layer 2	6	-1.00	0.00
	7	-0.00	0.00
	8	0.00	0.00
	9	5.49	0.00
	10	5.77	3.99
	11	5.77	4.40
	12	6.76	4.40
Top of Layer 3	13	-1.00	0.00
	14	-0.00	0.00
	15	0.00	0.00

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TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

#	X	Y1	Y2	Y3
1	-1.00	0.00	0.00	0.00
2	-0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.27	3.99	0.00	0.00
5	3.23	4.40	0.00	0.00
6	5.49	4.40	0.00	0.00
7	5.77	4.40	3.99	0.00
8	5.77	4.40	4.40	0.00
9	6.76	4.40	4.40	0.00

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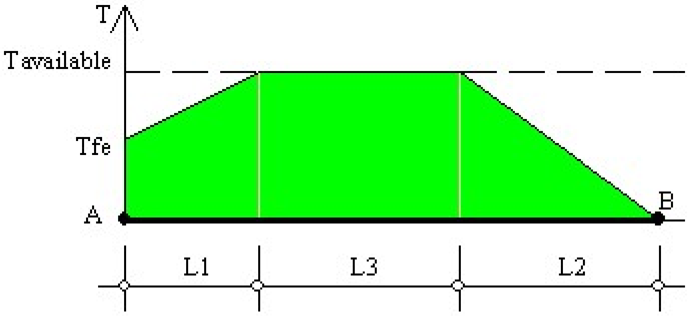
DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER



A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [m]	L [m]	L1 [m]	L2 [m]	L3 [m]	Tfe [kN/m]	Tavailable [kN/m]
1	---RW-95	0.22	5.49	0.00	0.89	4.60	33.63	33.63
2	---RW-95	0.66	5.08	0.00	1.00	4.08	33.63	33.63
3	---RW-95	1.10	4.72	0.00	1.13	3.59	33.63	33.63
4	---RW-95	1.54	3.00	0.00	1.36	1.64	33.63	33.63
5	---RW-95	1.98	3.00	0.00	1.63	1.37	33.63	33.63
6	---RW-95	2.42	3.00	0.00	2.04	0.96	33.63	33.63
7	---RW-95	2.86	3.00	0.00	2.77	0.23	33.63	33.63
8	---RW-95	3.30	3.00	0.00	3.00	0.00	24.00	24.00 (*)
9	---RW-95	3.74	3.00	0.00	3.00	0.00	12.32	12.32 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength.

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RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [m]		Exit Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	3.00	4.37	-5.86	0.04	-2.49	4.39	5.49	5.03	
2	3.90	4.40	-5.87	0.06	-1.96	4.42	5.86	2.38	
3	4.80	4.40	-5.32	0.09	-1.20	4.46	6.00	2.22	
4	5.70	4.40	-4.67	0.03	-0.45	4.50	6.15	1.91	
5	6.60	4.40	-4.73	0.06	-0.54	6.08	7.33	1.58	
6	7.50	4.40	-4.65	0.00	-0.36	7.13	8.32	1.42	
. 7	8.40	4.40	-4.69	0.03	0.08	7.55	8.90	1.35 .	OK
8	9.30	4.40	-5.86	0.03	-0.36	9.43	10.89	1.37	
9	10.20	4.40	-5.93	0.06	-0.39	11.61	12.81	1.44	
10	11.10	4.40	-5.84	0.01	-0.42	14.01	15.00	1.55	
11	12.00	4.40	-5.92	0.04	-0.44	16.51	17.36	1.65	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points).

Exit Point #	Exit Point (X, Y) [m]		Entry Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	-5.82	0.01	8.40	4.40	-0.88	9.25	10.47	1.36	
2	-5.34	0.06	8.40	4.40	-0.62	9.03	10.14	1.36	
. 3	-4.69	0.03	8.40	4.40	0.08	7.55	8.90	1.35 .	OK
4	-4.17	0.07	8.40	4.40	0.42	7.16	8.45	1.36	
5	-3.51	0.02	8.40	4.40	0.70	6.96	8.11	1.37	
6	-2.95	0.03	8.40	4.40	0.99	6.73	7.77	1.39	
7	-2.37	0.02	8.40	4.40	0.71	7.89	8.45	1.42	
8	-1.76	0.01	8.40	4.40	1.01	7.55	8.04	1.46	
9	-1.24	0.03	8.40	4.40	1.24	7.38	7.76	1.51	
10	-0.66	0.02	8.40	4.40	1.48	7.17	7.46	1.57	
11	-0.00	0.00	8.40	4.40	1.45	7.45	7.59	1.64	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

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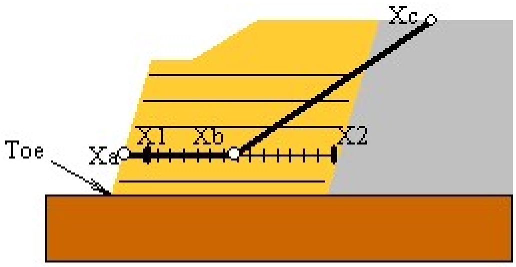
RESULTS OF TRANSLATIONAL ANALYSIS



Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [m]	(Xa, Ya) [m]		(Xb, Yb) [m]		(Xc, Yc) [m]		Fs	STATUS
At toe elevation	0.00	0.00	0.00	0.20	0.00	7.24	4.40	1.45	Minimum on Edge
Reinf. Layer #1	0.22	0.02	0.22	5.49	0.22	8.64	4.40	1.37	Minimum on Edge
. Reinf. Layer #2	0.66	0.05	0.66	5.09	0.66	8.46	4.40	1.35	Minimum on Edge
Reinf. Layer #3	1.10	0.08	1.10	4.79	1.10	8.33	4.40	1.35	Minimum on Edge
Reinf. Layer #4	1.54	0.11	1.54	3.09	1.54	7.17	4.40	1.41	Minimum on Edge
Reinf. Layer #5	1.98	0.14	1.98	3.09	1.98	6.82	4.40	1.51	Minimum on Edge
Reinf. Layer #6	2.42	0.17	2.42	3.19	2.42	6.49	4.40	1.63	Minimum on Edge
Reinf. Layer #7	2.86	0.20	2.86	3.19	2.86	5.86	4.40	1.89	Minimum on Edge
Reinf. Layer #8	3.30	0.23	3.30	3.19	3.30	5.10	4.40	2.39	Minimum on Edge
Reinf. Layer #9	3.74	0.26	3.74	3.29	3.74	4.17	4.40	2.95	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

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CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.35

Critical Circle: Xc = 0.08[m], Yc = 7.55[m], R = 8.90[m]. (Number of slices used = 58)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

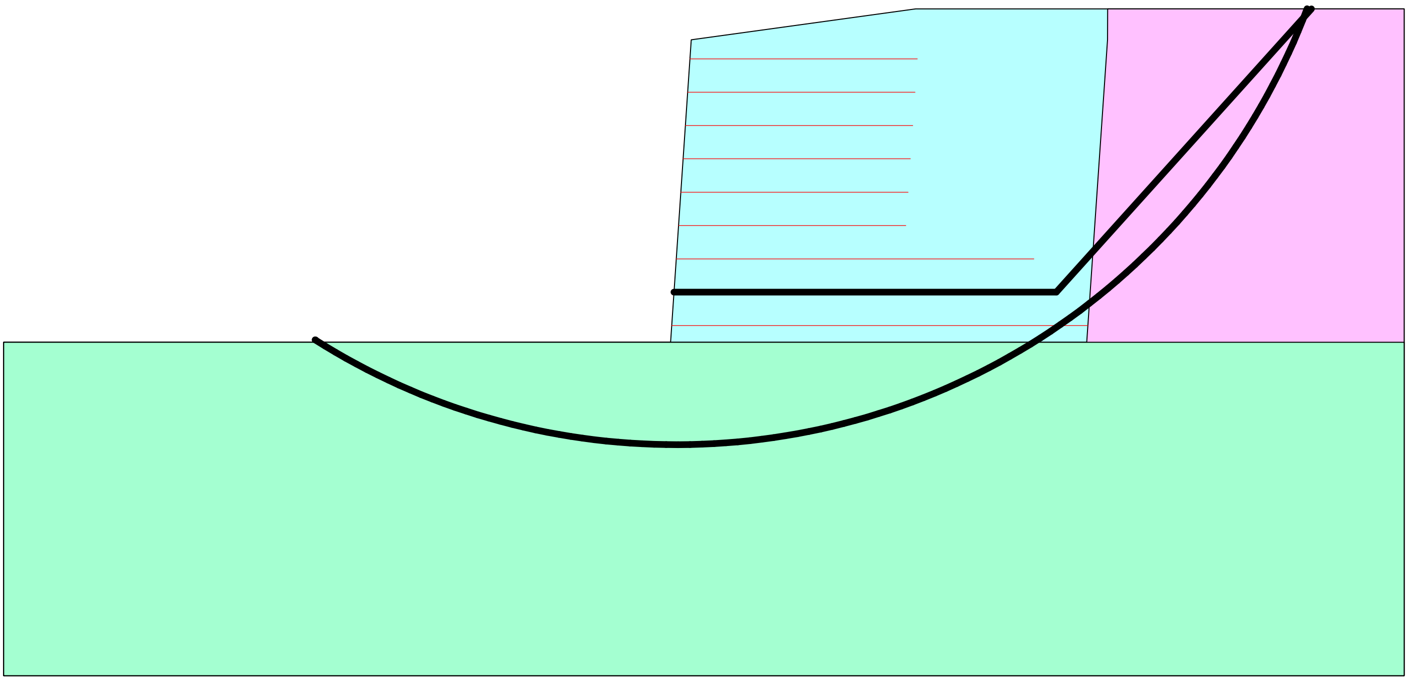
Minimum Factor of Safety = 1.35

Critical Two-Part Wedge: (Xa = 0.05, Ya = 0.66) [m]
(Xb = 5.09, Yb = 0.66) [m]
(Xc = 8.46, Yc = 4.40) [m]
(Number of slices used = 30)
Interslice resultant force inclination = 24.08 [degrees]

Three-Part Wedge Stability Analysis

N O T C O N D U C T E D

REINFORCEMENT LAYOUT: DRAWING



SCALE:

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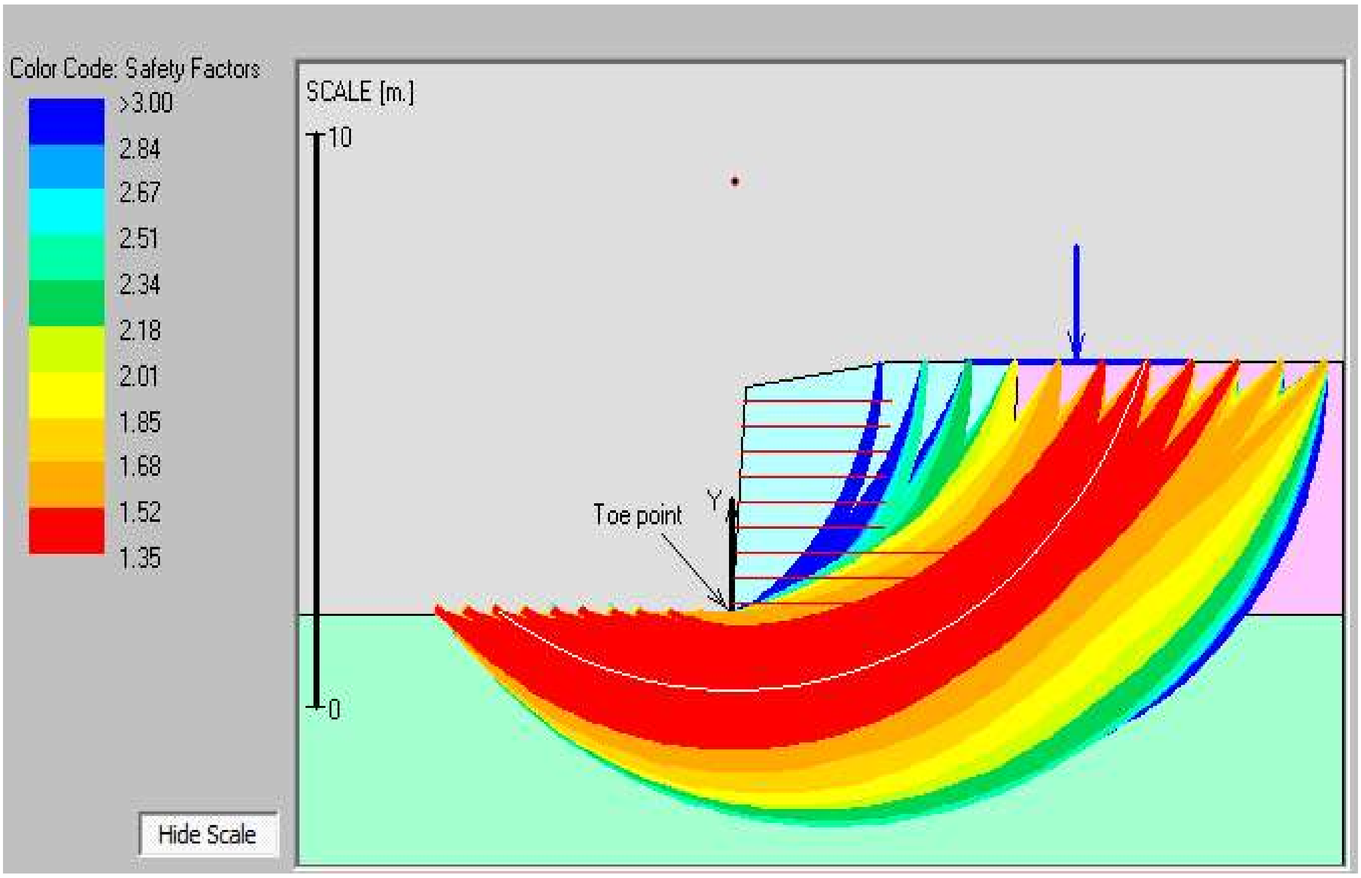
SAFETY MAP: BISHOP ROTATIONAL ANALYSIS MODE



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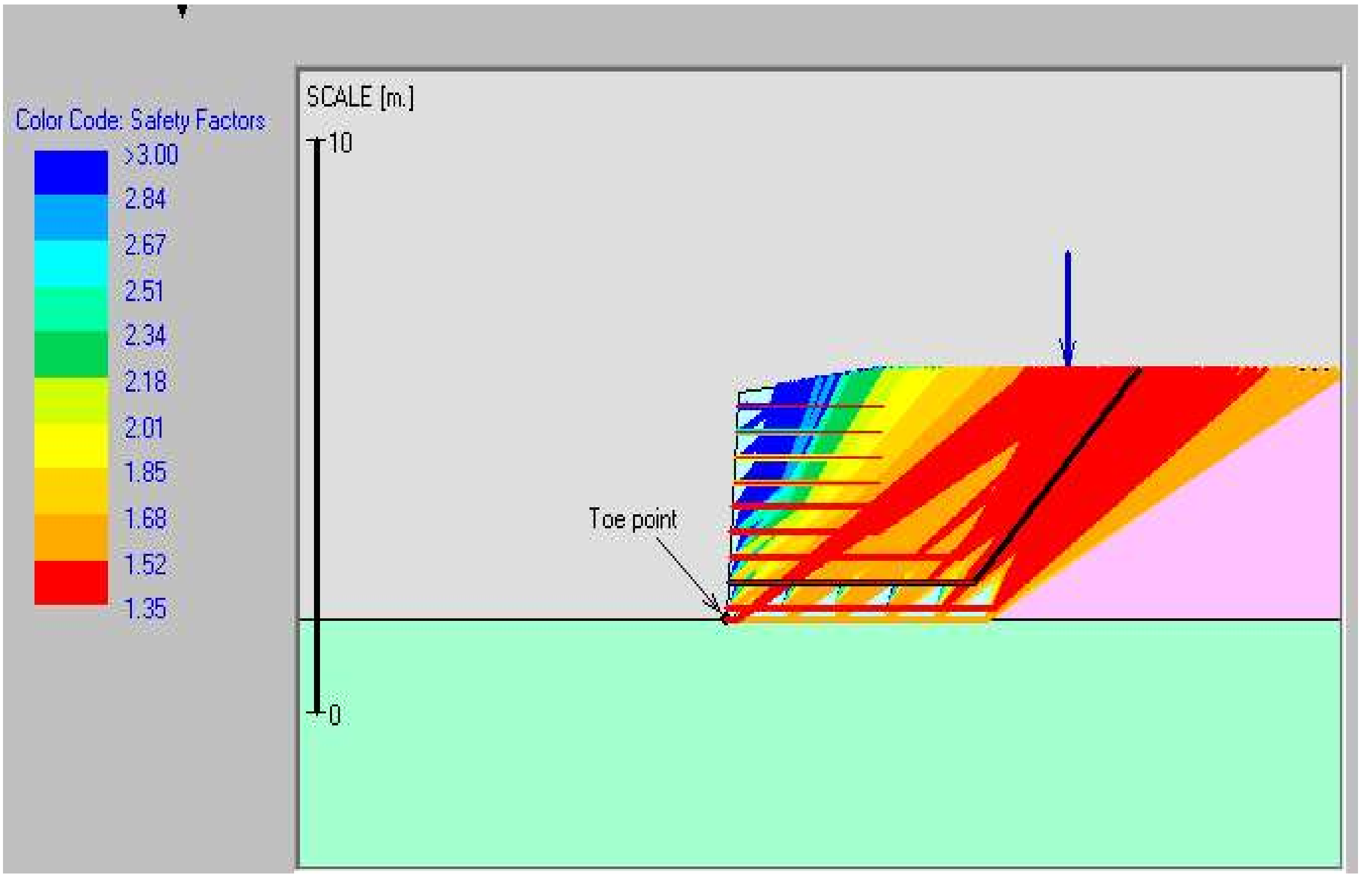
SAFETY MAP: SPENCER TRANSLATIONAL, 2-PART WEDGE



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AASHTO 2007 (LRFD)
km77+325（Combination A）

PROJECT IDENTIFICATION

Title: km77+325（Combination A）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+325（Combination A）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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SOIL DATA

REINFORCED SOIL

Unit weight, γ	19.5 kN/m^3
Design value of internal angle of friction, ϕ	33.0 °

RETAINED SOIL

Unit weight, γ	19.5 kN/m^3
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	18.5 kN/m^3
Equivalent internal angle of friction, $\phi_{equiv.}$	31.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3345 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 32.67 N γ= 25.99

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3197 Kae (Kh = 0) = 0.3079 Δ Kae = 0.0117 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

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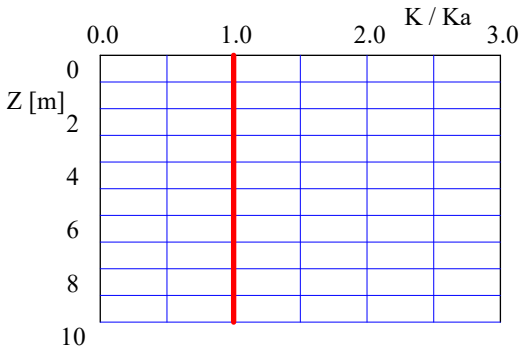
INPUT DATA: Geogrids (Analysis)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	N/A	N/A			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

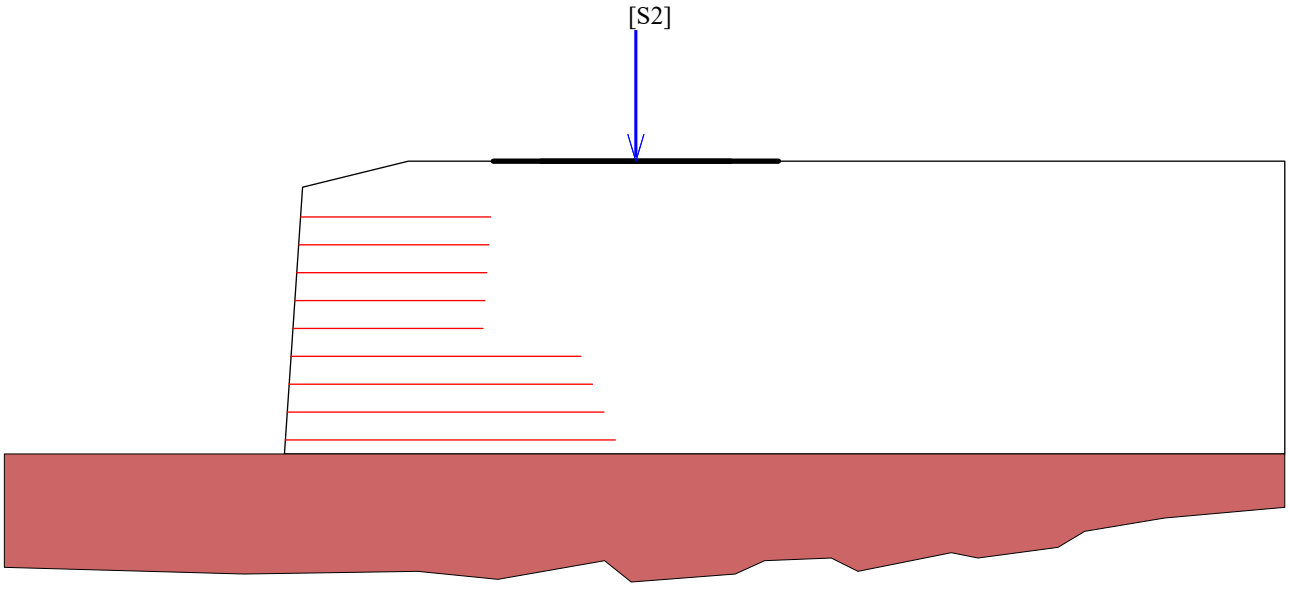
Design height, Hd 4.21 [m] { Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 4.21 m }
Batter, ω 3.9 [deg]
Backslope, β 13.8 [deg]
Backslope rise 0.4 [m]

Broken back equivalent angle, I = 2.79°(see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 12.5 and Qv-l = 0.0 [kPa].
Footing width, b=4.5 [m]. Distance of center of footing from wall face, d = 5.3 [m] @ depth of 0.0 [m] below soil surface.
[S2] Strip Load, Qv-d = 0.0 and Qv-l = 52.0 [kPa].
Footing width, b=3.0 [m]. Distance of center of footing from wall face, d = 5.3 [m] @ depth of 0.0 [m] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.50		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.50		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.77		0.90

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.50	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.50	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.50

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	0.83		0.90
Reinforced Soil and Reinforcement	ϕ_τ	0.77		0.90

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
	ϕ_b	0.74		0.90

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ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 5.34, Meyerhof stress = 164.27 kPa.

Foundation Interface: Direct sliding, CDR = 1.702, Eccentricity, e/L = 0.0862, CDR-overturning = 4.36

GEOGRID #	Elevation [m]	Length [m]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	5.21	1	N/A	N/A	N/A	1.862	14.831	1.342	0.0787	---RW-95
2	0.66	5.00	1	N/A	N/A	N/A	2.076	13.918	1.320	0.0737	---RW-95
3	1.10	4.79	1	N/A	N/A	N/A	2.344	12.870	1.298	0.0676	---RW-95
4	1.54	4.58	1	N/A	N/A	N/A	2.692	11.838	1.274	0.0600	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	3.161	6.301	1.419	0.0457	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	3.829	5.837	1.686	0.0232	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	4.853	5.371	2.219	0.0045	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	6.627	4.921	2.646	-0.0129	---RW-95
9	3.74	3.00	1	N/A	N/A	N/A	7.964	3.508	3.036	-0.0370	---RW-95

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, CDR = 8.61, Meyerhof stress = 121.06 kPa.

Foundation Interface: Direct sliding, CDR = 1.449, Eccentricity, e/L = 0.1231, Fs-overturning = 3.27

GEOGRID #	Elevation [m]	Length [m]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	5.21	1	N/A	N/A	N/A	1.798	12.845	1.227	0.1131	---RW-95
2	0.66	5.00	1	N/A	N/A	N/A	2.002	12.034	1.195	0.1071	---RW-95
3	1.10	4.79	1	N/A	N/A	N/A	2.259	11.105	1.163	0.0993	---RW-95
4	1.54	4.58	1	N/A	N/A	N/A	2.591	10.187	1.131	0.0896	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	3.086	5.587	1.316	0.0668	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	3.729	5.152	1.566	0.0378	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	4.712	4.708	2.095	0.0146	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	6.399	4.262	2.468	-0.0057	---RW-95
9	3.74	3.00	1	N/A	N/A	N/A	7.683	3.033	2.748	-0.0325	---RW-95

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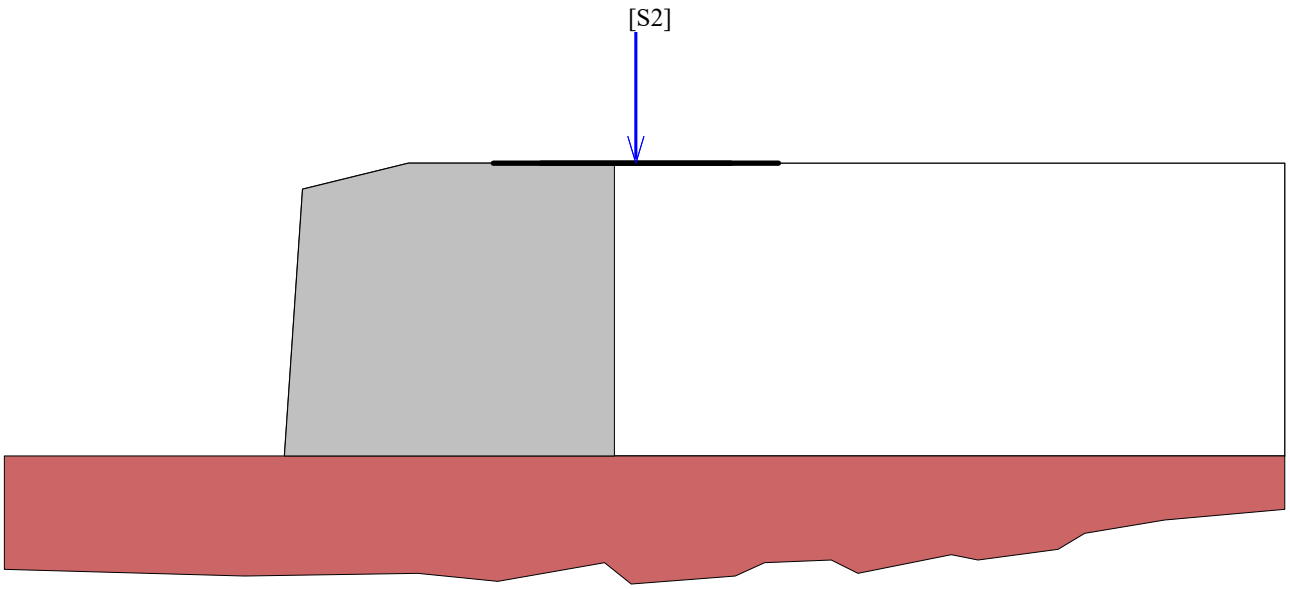
BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	876.6	1042.9	[kPa]
Meyerhof stress, σ_V	164.27	121.1	[kPa]
Eccentricity, e	0.14	0.19	[m]
Eccentricity, e/L	0.027	0.037	
CDR calculated	5.34	8.61	
Base length	5.21	5.21	[m]



SCALE:

0 2 4 6 [m]

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DIRECT SLIDING for GIVEN LAYOUT
(for GEOGRID reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.702 and CDR-seismic = 1.449

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	5.21	1.342	1.227	1	---RW-95
2	0.66	5.00	1.320	1.195	1	---RW-95
3	1.10	4.79	1.298	1.163	1	---RW-95
4	1.54	4.58	1.274	1.131	1	---RW-95
5	1.98	3.00	1.419	1.316	1	---RW-95
6	2.42	3.00	1.686	1.566	1	---RW-95
7	2.86	3.00	2.219	2.095	1	---RW-95
8	3.30	3.00	2.646	2.468	1	---RW-95
9	3.74	3.00	3.036	2.748	1	---RW-95

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = 0.0862, e/L seismic = 0.1231; Overturning: CDR-static = 4.36, CDR-seismic = 3.27

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	5.21	0.0787	0.1131	1	---RW-95
2	0.66	5.00	0.0737	0.1071	1	---RW-95
3	1.10	4.79	0.0676	0.0993	1	---RW-95
4	1.54	4.58	0.0600	0.0896	1	---RW-95
5	1.98	3.00	0.0457	0.0668	1	---RW-95
6	2.42	3.00	0.0232	0.0378	1	---RW-95
7	2.86	3.00	0.0045	0.0146	1	---RW-95
8	3.30	3.00	-0.0129	-0.0057	1	---RW-95
9	3.74	3.00	-0.0370	-0.0325	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	16.25	1.29	N/A	1.862	N/A	1.798	---RW-95
2	0.66	30.3	14.58	1.19	N/A	2.076	N/A	2.002	---RW-95
3	1.10	30.3	12.91	1.08	N/A	2.344	N/A	2.259	---RW-95
4	1.54	30.3	11.24	0.97	N/A	2.692	N/A	2.591	---RW-95
5	1.98	30.3	9.58	0.52	N/A	3.161	N/A	3.086	---RW-95
6	2.42	30.3	7.91	0.47	N/A	3.829	N/A	3.729	---RW-95
7	2.86	30.3	6.24	0.42	N/A	4.853	N/A	4.712	---RW-95
8	3.30	30.3	4.57	0.36	N/A	6.627	N/A	6.399	---RW-95
9	3.74	30.3	3.80	0.31	N/A	7.964	N/A	7.683	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	16.25	1.29	5.10	0.10	241.0	N/A	14.831	225.4	N/A	12.845
2	0.66	1.000	14.58	1.19	4.69	0.31	203.0	N/A	13.918	189.8	N/A	12.034
3	1.10	1.000	12.91	1.08	4.27	0.52	166.2	N/A	12.870	155.4	N/A	11.105
4	1.54	1.000	11.24	0.97	3.84	0.73	133.1	N/A	11.838	124.5	N/A	10.187
5	1.98	1.000	9.58	0.52	2.06	0.94	60.3	N/A	6.301	56.4	N/A	5.587
6	2.42	1.000	7.91	0.47	1.85	1.15	46.1	N/A	5.837	43.1	N/A	5.152
7	2.86	1.000	6.24	0.42	1.64	1.36	33.5	N/A	5.371	31.3	N/A	4.708
8	3.30	1.000	4.57	0.36	1.43	1.57	22.5	N/A	4.921	21.0	N/A	4.262
9	3.74	1.000	3.80	0.31	1.22	1.78	13.3	N/A	3.508	12.5	N/A	3.033

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AASHTO 2007 (LRFD)
km77+325（Combination B）

PROJECT IDENTIFICATION

Title: km77+325（Combination B）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+325（Combination B）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: DESIGN
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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DESIGN DATA

DESIGN OBJECTIVES

Minimum Capacity Demand Ratio in pullout, CDR-po	1.10
Minimum Capacity Demand Ratio in direct sliding, CDR-sliding	1.10
Maximum allowable eccentricity ratio at each reinforcement level, e/L	0.2500
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-static	1.30
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-seismic	1.10

Prescribed minimum resistive length to prevent pullout, Le = 1.00 m.
Prescribed minimum normalized length of each layer is: L/Hd = 0.70 --> L = 2.95 m.
Prescribed minimum absolute total length of each layer is: L = 3.00 m.

BEARING CAPACITY

Bearing capacity is controlled by general shear.

Maximum permissible eccentricity ratio (soil), e/L	0.2500
Min. Capacity Demand Ratio with respect to ultimate bearing capacity (Meyerhof approach)	1.10

Bearing capacity coefficients: Nc = 32.67 N_γ = 25.99

SOIL DATA

REINFORCED SOIL

Unit weight, γ	19.5 kN/m^3
Design value of internal angle of friction, ϕ	33.0 °

RETAINED SOIL

Unit weight, γ	19.5 kN/m^3
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	18.5 kN/m^3
Equivalent internal angle of friction, $\phi_{equiv.}$	31.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized
Inclination of internal slip plane, Ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3345 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3197 Kae (Kh = 0) = 0.3079 Δ Kae = 0.0117 (see eq. 37 in DEMO 82)

DIRECT SLIDING / ECCENTRICITY

Seismic CDR is 100.0% of specified static CDR for direct sliding.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

BEARING CAPACITY

Seismic CDR is 100.0% of specified static CDR for bearing capacity.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

INTERNAL STABILITY

Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.
Seismic Capacity Demand Ratio in pullout, CDR-po, is 100.0% of its specified static value.
Seismic Capacity Demand Ratio, CDR-overall, is 100.0% of its specified static value.
The reduction of CDR pertains to geogrid strength and to connection strength for break mode of failure.

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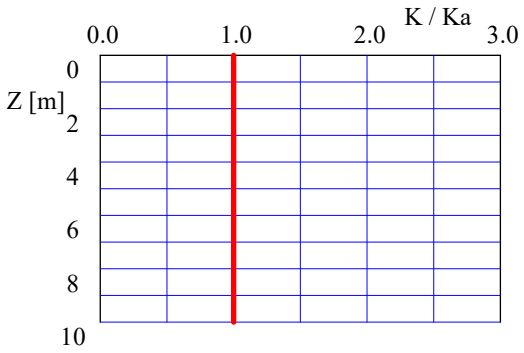
INPUT DATA: Geogrids
(Multiple type reinforcement)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	1.00	1.00			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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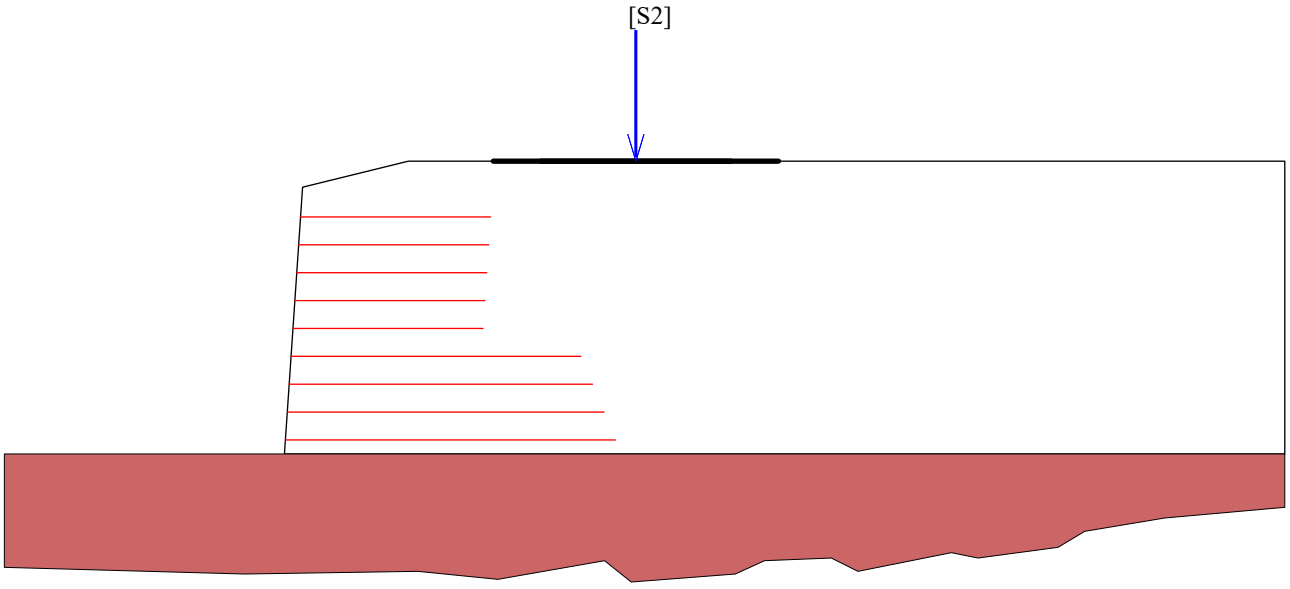
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	4.21	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 4.21 m }
Batter, ω	3.9	[deg]	
Backslope, β	13.8	[deg]	
Backslope rise	0.4	[m]	Broken back equivalent angle, I = 2.79° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 12.5 and Qv-l = 0.0 [kPa].
Footing width, b=4.5 [m]. Distance of center of footing from wall face, d = 5.3 [m] @ depth of 0.0 [m] below soil surface.
[S2] Strip Load, Qv-d = 0.0 and Qv-l = 52.0 [kPa].
Footing width, b=3.0 [m]. Distance of center of footing from wall face, d = 5.3 [m] @ depth of 0.0 [m] below soil surface.

DESIGNED REINFORCEMENT LAYOUT:



SCALE:

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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.00		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.00		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.00		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Geogrid:		0.90		0.90

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.77		0.90

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	0.83		0.90
Reinforced Soil and Reinforcement	ϕ_τ	0.77		0.90

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
	ϕ_b	0.74		0.90

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REINFORCEMENT LAYOUT AND DESIGN CRITERIA

LEGEND: (1) Connection strength √ Satisfactory
(2) Geogrid strength ⊗ Unsatisfactory
(3) Pullout resistance
(4) Direct sliding
(5) Eccentricity

Bearing capacity: √
Foudation Interface: Direct sliding √ Eccentricity √

#	Geogrid Elevation [m]	Length [m]	Type #	(1)	(2)	(3)	(4)	(5)
1	0.22	5.21	1	N/A	√	√	√	√
2	0.66	5.00	1	N/A	√	√	√	√
3	1.10	4.79	1	N/A	√	√	√	√
4	1.54	4.58	1	N/A	√	√	√	√
5	1.98	3.00	1	N/A	√	√	√	√
6	2.42	3.00	1	N/A	√	√	√	√
7	2.86	3.00	1	N/A	√	√	√	√
8	3.30	3.00	1	N/A	√	√	√	√
9	3.74	3.00	1	N/A	√	√	√	√

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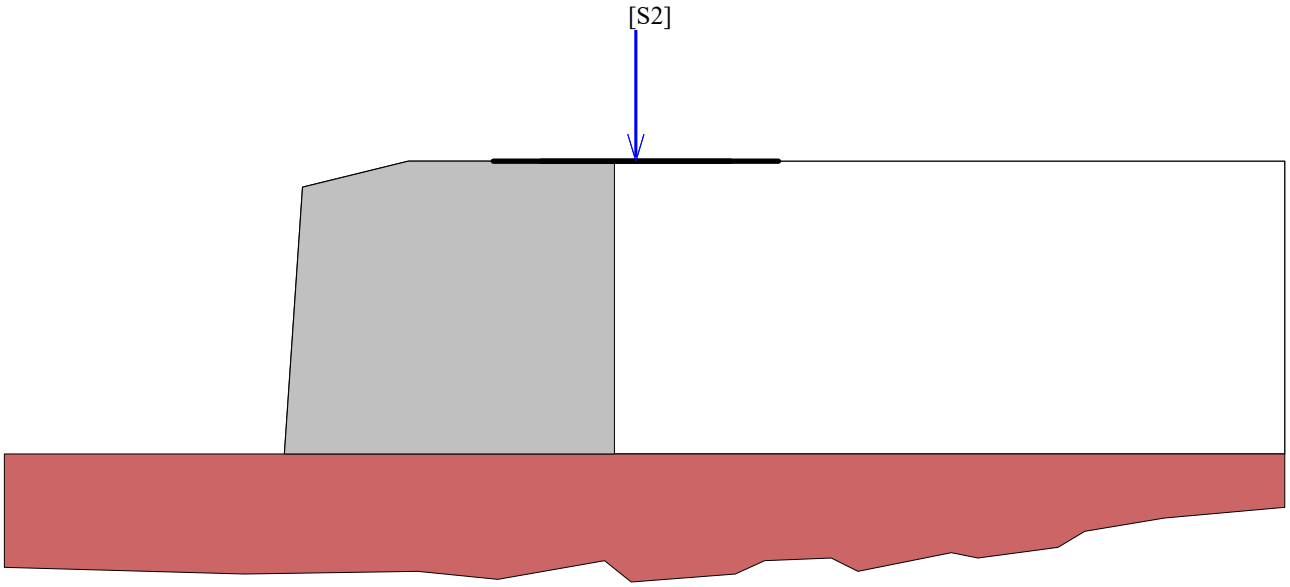
BEARING CAPACITY for DESIGNED LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	844.4	1057.2	[kPa]
Meyerhof stress, σ_V	114.04	110.5	[kPa]
Eccentricity, e	0.23	0.16	[m]
Eccentricity, e/L	0.044	0.031	
CDR calculated	7.40	9.57	
Base length	5.21	5.21	[m]



SCALE:

0 2 4 6 [m]

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DIRECT SLIDING for DESIGNED LAYOUT
(for GEOGRID reinforcements)

Specified CDR-static = 1.100 and CDR-seismic = 1.100

Along reinforced and foundation soils interface: CDR-static = 1.387 and CDR-seismic = 1.814

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	5.21	1.101	1.545	1	---RW-95
2	0.66	5.00	1.101	1.525	1	---RW-95
3	1.10	4.79	1.101	1.506	1	---RW-95
4	1.54	4.58	1.101	1.485	1	---RW-95
5	1.98	3.00	1.106	1.603	1	---RW-95
6	2.42	3.00	1.314	1.909	1	---RW-95
7	2.86	3.00	1.704	2.517	1	---RW-95
8	3.30	3.00	2.074	3.025	1	---RW-95
9	3.74	3.00	2.487	3.511	1	---RW-95

ECCENTRICITY for DESIGNED LAYOUT

At interface with foundation: e/L static = 0.0988, e/L seismic = 0.0839; Overturning: CDR-static = 3.82, CDR-seismic = 4.31

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	5.21	0.0892	0.0758	1	---RW-95
2	0.66	5.00	0.0816	0.0699	1	---RW-95
3	1.10	4.79	0.0728	0.0627	1	---RW-95
4	1.54	4.58	0.0624	0.0540	1	---RW-95
5	1.98	3.00	0.0665	0.0497	1	---RW-95
6	2.42	3.00	0.0375	0.0257	1	---RW-95
7	2.86	3.00	0.0135	0.0058	1	---RW-95
8	3.30	3.00	-0.0079	-0.0123	1	---RW-95
9	3.74	3.00	-0.0349	-0.0369	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	10.8	1.3	1.000	2.794	1.000	2.652	---RW-95
2	0.66	30.3	9.7	1.2	1.000	3.113	1.000	2.952	---RW-95
3	1.10	30.3	8.6	1.1	1.000	3.516	1.000	3.328	---RW-95
4	1.54	30.3	7.5	1.0	1.000	4.038	1.000	3.815	---RW-95
5	1.98	30.3	6.4	0.5	1.000	4.742	1.000	4.574	---RW-95
6	2.42	30.3	5.3	0.5	1.000	5.743	1.000	5.522	---RW-95
7	2.86	30.3	4.2	0.4	1.000	7.280	1.000	6.967	---RW-95
8	3.30	30.3	3.0	0.4	1.000	9.941	1.000	9.436	---RW-95
9	3.74	30.3	2.5	0.3	1.000	11.946	1.000	11.324	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	10.84	1.29	5.10	0.10	241.0	1.100	22.246	225.4	1.100	18.583
2	0.66	1.000	9.72	1.19	4.69	0.31	203.0	1.100	20.877	189.8	1.100	17.397
3	1.10	1.000	8.61	1.08	4.27	0.52	166.2	1.100	19.306	155.4	1.100	16.038
4	1.54	1.000	7.50	0.97	3.84	0.73	133.1	1.100	17.757	124.5	1.100	14.694
5	1.98	1.000	6.38	0.52	2.06	0.94	60.3	1.100	9.451	56.4	1.100	8.169
6	2.42	1.000	5.27	0.47	1.85	1.15	46.1	1.100	8.755	43.1	1.100	7.517
7	2.86	1.000	4.16	0.42	1.64	1.36	33.5	1.100	8.056	31.3	1.100	6.848
8	3.30	1.000	3.04	0.36	1.43	1.57	22.5	1.100	7.381	21.0	1.100	6.166
9	3.74	1.000	2.53	0.31	1.22	1.78	13.3	1.100	5.262	12.5	1.100	4.384

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AASHTO 2007 (LRFD)
km77+325（Combination C）

PROJECT IDENTIFICATION

Title: km77+325（Combination C）
Project Number:
Client:
Designer: 戴征杰（BOSTD）
Station Number:

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\Dell\Desktop\2021\km77+325（Combination C）.BEN
Original date and time of creating this file: Wed Mar 24 14:26:26 2021

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

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SOIL DATA

REINFORCED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 33.0 °

RETAINED SOIL
Unit weight, γ 19.5 kN/m ^{3}
Design value of internal angle of friction, ϕ 30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)
Equivalent unit weight, $\gamma_{equiv.}$ 18.5 kN/m ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$ 31.0 °
Equivalent cohesion, $c_{equiv.}$ 0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2948 (if batter is less than 10° Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized
Inclination of internal slip plane, ψ = 61.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3345 (if batter is less than 10° Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 32.67 N γ= 25.99

SEISMICITY

Maximum ground acceleration coefficient, A = 0.050
Design acceleration coefficient in Internal Stability: Kh = 0.070
Design acceleration coefficient in External Stability: Kh = 0.019
(Kh in External Stability is based on allowable displacement, d = 100 mm.)

Kae (Kh > 0) = 0.3197 Kae (Kh = 0) = 0.3079 Δ Kae = 0.0117 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

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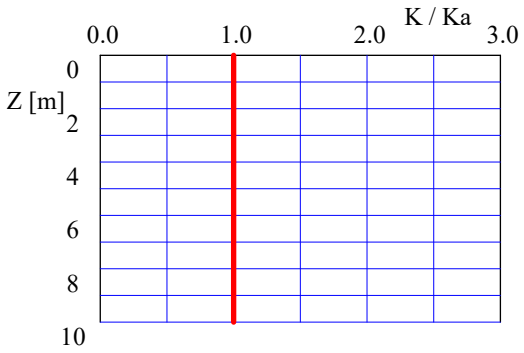
INPUT DATA: Geogrids (Analysis)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	95.7	127.3			
Durability reduction factor, RFd	1.10	1.10			
Installation-damage reduction factor, RFid	1.16	1.12			
Creep reduction factor, RFc	2.23	2.23	N/A	N/A	N/A
CDR for strength	N/A	N/A			
Coverage ratio, Rc	1.000	1.000			
Friction angle along geogrid-soil interface, ρ	26.57	26.57			
Pullout resistance factor, F*	0.67tanϕ	0.67tanϕ	N/A	N/A	N/A
Scale-effect correction factor, α	0.8	0.8			

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



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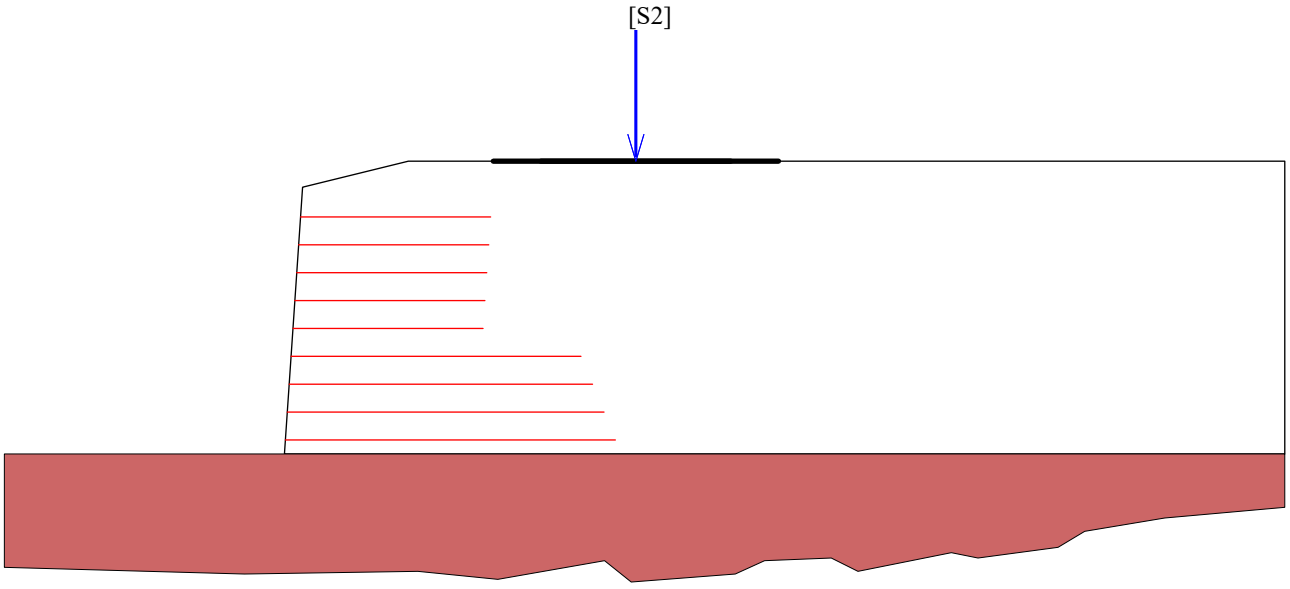
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	4.21	[m]	{ Embedded depth is E = 0.00 m, and height above top of finished bottom grade is H = 4.21 m }
Batter, ω	3.9	[deg]	
Backslope, β	13.8	[deg]	
Backslope rise	0.4	[m]	Broken back equivalent angle, I = 2.79° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 12.5 and Qv-l = 0.0 [kPa].
Footing width, b=4.5 [m]. Distance of center of footing from wall face, d = 5.3 [m] @ depth of 0.0 [m] below soil surface.
[S2] Strip Load, Qv-d = 0.0 and Qv-l = 52.0 [kPa].
Footing width, b=3.0 [m]. Distance of center of footing from wall face, d = 5.3 [m] @ depth of 0.0 [m] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

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AASHTO 2007 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.00	
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00	
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.00	
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.00	

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Geogrid:		0.90	1.00

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	1.00	1.00

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.00
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.00
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 10.5.5.2.2-1:		Static	Combined Static/Seismic
	ϕ_b	1.00	1.00

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ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 10.82, Meyerhof stress = 109.51 kPa.
Foundation Interface: Direct sliding, CDR = 2.085, Eccentricity, e/L = 0.0795, CDR-overturning = 4.47

GEOGRID #	Elevation [m]	Length [m]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	5.21	1	N/A	N/A	N/A	2.794	28.891	1.774	0.0718	---RW-95
2	0.66	5.00	1	N/A	N/A	N/A	3.113	27.113	1.747	0.0664	---RW-95
3	1.10	4.79	1	N/A	N/A	N/A	3.516	25.072	1.718	0.0598	---RW-95
4	1.54	4.58	1	N/A	N/A	N/A	4.038	23.061	1.689	0.0517	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	4.742	12.274	1.843	0.0457	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	5.743	11.370	2.190	0.0232	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	7.280	10.463	2.882	0.0045	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	9.941	9.586	3.437	-0.0129	---RW-95
9	3.74	3.00	1	N/A	N/A	N/A	11.946	6.834	3.943	-0.0370	---RW-95

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, CDR = 10.63, Meyerhof stress = 110.45 kPa.
Foundation Interface: Direct sliding, CDR = 2.016, Eccentricity, e/L = 0.0839, Fs-overturning = 4.31

GEOGRID #	Elevation [m]	Length [m]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [geogrid strength]	Geogrid strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.22	5.21	1	N/A	N/A	N/A	2.946	20.648	1.717	0.0758	---RW-95
2	0.66	5.00	1	N/A	N/A	N/A	3.280	19.330	1.695	0.0699	---RW-95
3	1.10	4.79	1	N/A	N/A	N/A	3.698	17.820	1.673	0.0627	---RW-95
4	1.54	4.58	1	N/A	N/A	N/A	4.239	16.327	1.650	0.0540	---RW-95
5	1.98	3.00	1	N/A	N/A	N/A	5.082	9.077	1.781	0.0497	---RW-95
6	2.42	3.00	1	N/A	N/A	N/A	6.136	8.353	2.122	0.0257	---RW-95
7	2.86	3.00	1	N/A	N/A	N/A	7.741	7.608	2.797	0.0058	---RW-95
8	3.30	3.00	1	N/A	N/A	N/A	10.485	6.851	3.361	-0.0123	---RW-95
9	3.74	3.00	1	N/A	N/A	N/A	12.582	4.871	3.901	-0.0369	---RW-95

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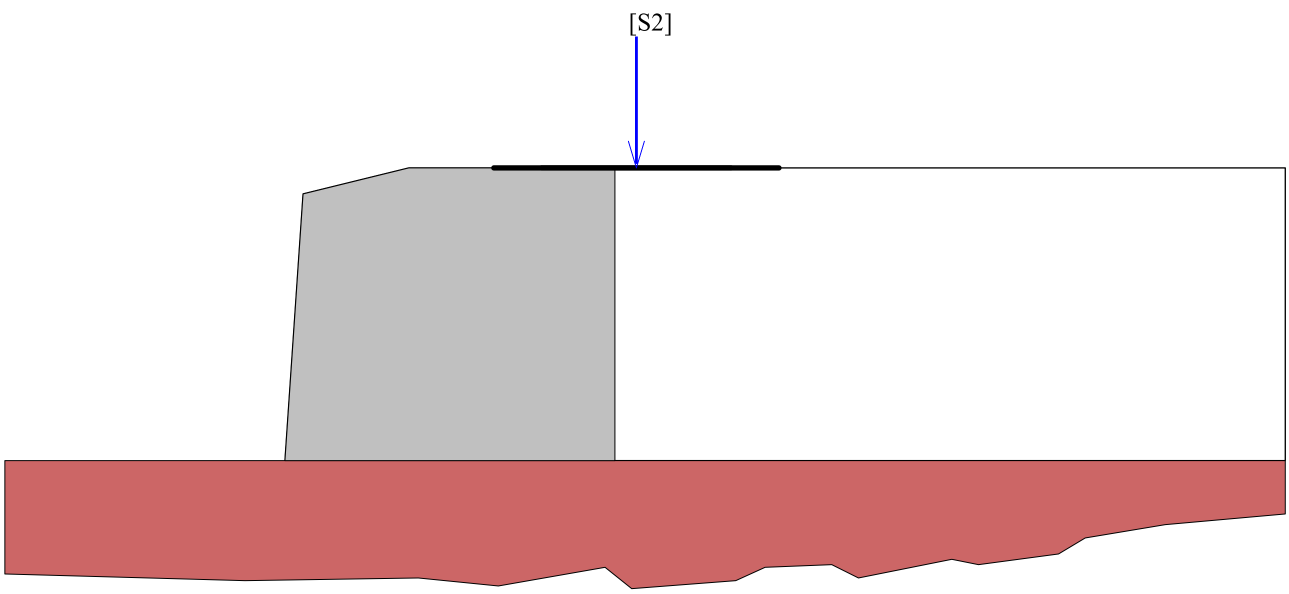
BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	1184.6	1174.6	[kPa]
Meyerhof stress, σ_V	109.51	110.5	[kPa]
Eccentricity, e	0.14	0.16	[m]
Eccentricity, e/L	0.027	0.031	
CDR calculated	10.82	10.63	
Base length	5.21	5.21	[m]



SCALE:

0 2 4 6 [m]

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DIRECT SLIDING for GIVEN LAYOUT (for GEOGRID reinforcements)

Along reinforced and foundation soils interface: CDR-static = 2.085 and CDR-seismic = 2.016

#	Geogrid Elevation [m]	Geogrid Length [m]	CDR Static	CDR Seismic	Geogrid Type #	Product name
1	0.22	5.21	1.774	1.717	1	---RW-95
2	0.66	5.00	1.747	1.695	1	---RW-95
3	1.10	4.79	1.718	1.673	1	---RW-95
4	1.54	4.58	1.689	1.650	1	---RW-95
5	1.98	3.00	1.843	1.781	1	---RW-95
6	2.42	3.00	2.190	2.122	1	---RW-95
7	2.86	3.00	2.882	2.797	1	---RW-95
8	3.30	3.00	3.437	3.361	1	---RW-95
9	3.74	3.00	3.943	3.901	1	---RW-95

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = 0.0795, e/L seismic = 0.0839; Overturning: CDR-static = 4.47, CDR-seismic = 4.31

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.22	5.21	0.0718	0.0758	1	---RW-95
2	0.66	5.00	0.0664	0.0699	1	---RW-95
3	1.10	4.79	0.0598	0.0627	1	---RW-95
4	1.54	4.58	0.0517	0.0540	1	---RW-95
5	1.98	3.00	0.0457	0.0497	1	---RW-95
6	2.42	3.00	0.0232	0.0257	1	---RW-95
7	2.86	3.00	0.0045	0.0058	1	---RW-95
8	3.30	3.00	-0.0129	-0.0123	1	---RW-95
9	3.74	3.00	-0.0370	-0.0369	1	---RW-95

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RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum CDR static	Actual calculated CDR static	Specified minimum CDR seismic	Actual calculated CDR seismic	Product name
1	0.22	30.3	10.84	1.29	N/A	2.794	N/A	2.946	---RW-95
2	0.66	30.3	9.72	1.19	N/A	3.113	N/A	3.280	---RW-95
3	1.10	30.3	8.61	1.08	N/A	3.516	N/A	3.698	---RW-95
4	1.54	30.3	7.50	0.97	N/A	4.038	N/A	4.239	---RW-95
5	1.98	30.3	6.38	0.52	N/A	4.742	N/A	5.082	---RW-95
6	2.42	30.3	5.27	0.47	N/A	5.743	N/A	6.136	---RW-95
7	2.86	30.3	4.16	0.42	N/A	7.280	N/A	7.741	---RW-95
8	3.30	30.3	3.04	0.36	N/A	9.941	N/A	10.485	---RW-95
9	3.74	30.3	2.53	0.31	N/A	11.946	N/A	12.582	---RW-95

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic CDR	Actual Seismic CDR
1	0.22	1.000	10.84	1.29	5.10	0.10	313.0	N/A	28.891	250.4	N/A	20.648
2	0.66	1.000	9.72	1.19	4.69	0.31	263.6	N/A	27.113	210.9	N/A	19.330
3	1.10	1.000	8.61	1.08	4.27	0.52	215.9	N/A	25.072	172.7	N/A	17.820
4	1.54	1.000	7.50	0.97	3.84	0.73	172.9	N/A	23.061	138.3	N/A	16.327
5	1.98	1.000	6.38	0.52	2.06	0.94	78.4	N/A	12.274	62.7	N/A	9.077
6	2.42	1.000	5.27	0.47	1.85	1.15	59.9	N/A	11.370	47.9	N/A	8.353
7	2.86	1.000	4.16	0.42	1.64	1.36	43.5	N/A	10.463	34.8	N/A	7.608
8	3.30	1.000	3.04	0.36	1.43	1.57	29.2	N/A	9.586	23.4	N/A	6.851
9	3.74	1.000	2.53	0.31	1.22	1.78	17.3	N/A	6.834	13.9	N/A	4.871

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Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0

77+325 overall stability(no seismicity)

Report created by ReSSA(3.0): Update #4.21: Copyright (c) 2001-2016, ADAMA Engineering, Inc.

PROJECT IDENTIFICATION

Title: 77+325 overall stability(no seismicity)
Project Number: -
Client:
Designer: 戴征杰（BOSTD）

Description:

Company's information:

Name: China Railway Design Corporation Serbia Ogranak Beogrda
Street: Koste Racina 16b, 11000 Belgrade, Serbia

Telephone #:
Fax #:
E-Mail:

Original file path and name:
Original date and time of creating this file: Thu Apr 08 11:48:52 2021

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0

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INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [kN/m^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [kPa]
1....... Reinforced Soil.................................	19.5	33.0	0.0
2....... Retained Soil.....................................	19.5	30.0	0.0
3....... Foundation Soil.................................	18.5	31.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [kN/m]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Additional Reduction Factor, RFa	Coverage Ratio, Rc
1	---RW-95	95.70	1.16	1.10	2.23	1.00	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
1	---RW-95	0.77	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Not Applicable

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DRAWING OF SPECIFIED GEOMETRY - GENERAL - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

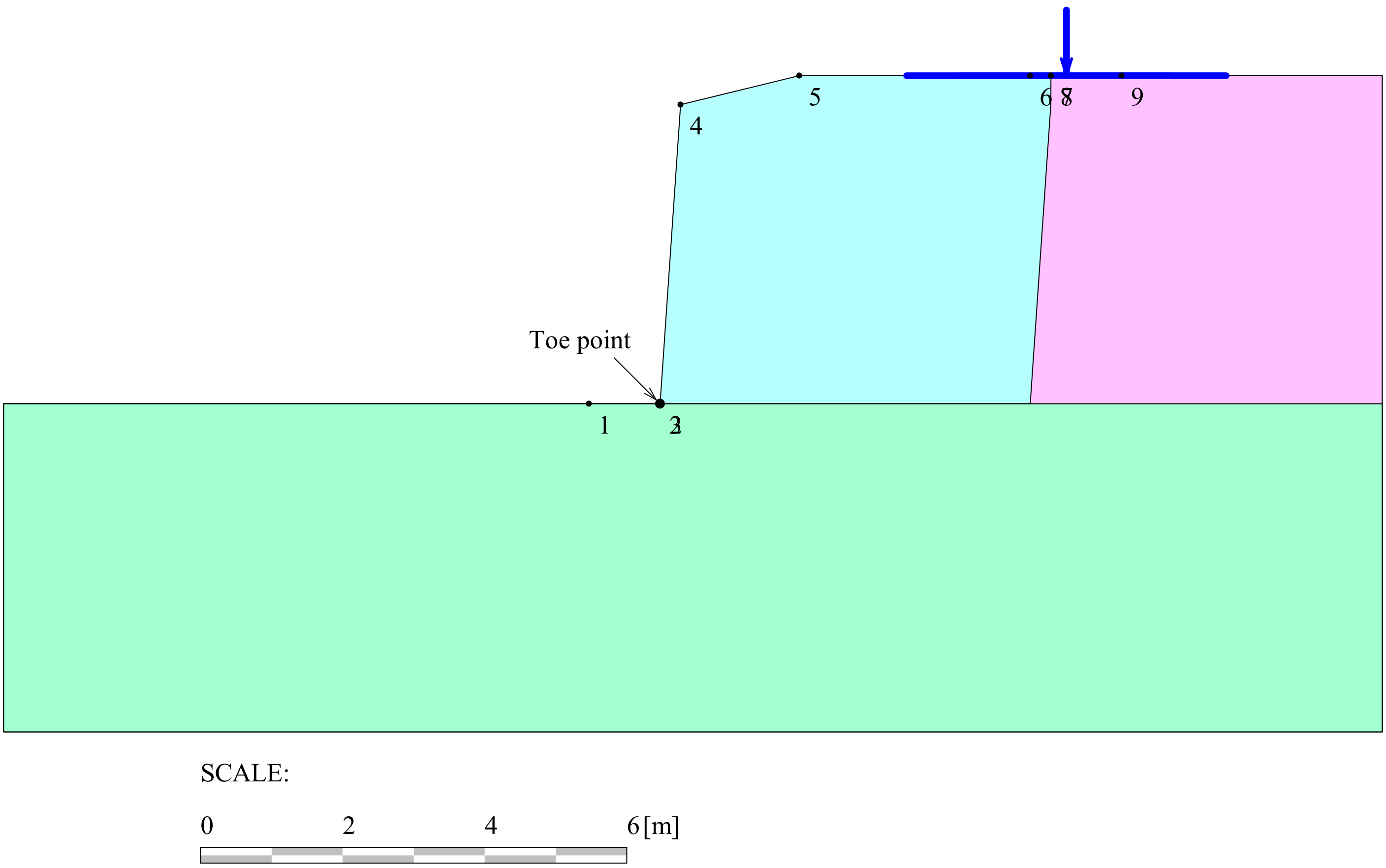
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Surcharge load, Q1....................................None
Surcharge load, Q2....................................None
Surcharge load, Q3....................................None

STRIP LOAD

Strip Load #1.. 12.50 [kPa] Width of base, b = 4.50 [m] Distance from toe point, d = 5.72 [m]
Strip Load #2.. 52.00 [kPa] Width of base, b = 3.00 [m] Distance from toe point, d = 5.72 [m]



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TABULATED DETAILS OF GEMERAL SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

	#	Xi	Yi
Top of Layer 1	1	-1.00	0.00
	2	-0.00	0.00
	3	0.00	0.00
	4	0.29	4.21
	5	1.96	4.62
Top of Layer 2	6	-1.00	0.00
	7	-0.00	0.00
	8	0.00	0.00
	9	5.21	0.00
	10	5.50	4.21
	11	5.50	4.62
	12	6.50	4.62
Top of Layer 3	13	-1.00	0.00
	14	-0.00	0.00
	15	0.00	0.00

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TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

#	X	Y1	Y2	Y3
1	-1.00	0.00	0.00	0.00
2	-0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.29	4.21	0.00	0.00
5	1.96	4.62	0.00	0.00
6	5.21	4.62	0.00	0.00
7	5.50	4.62	4.21	0.00
8	5.50	4.62	4.62	0.00
9	6.50	4.62	4.62	0.00

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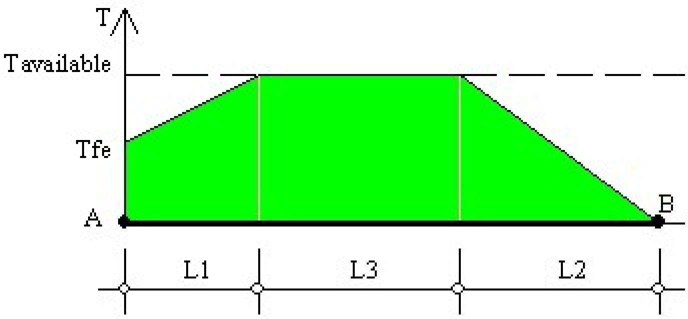
DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER



A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [m]	L [m]	L1 [m]	L2 [m]	L3 [m]	Tfe [kN/m]	Tavailable [kN/m]
1	---RW-95	0.22	5.21	0.00	0.85	4.36	33.63	33.63
2	---RW-95	0.66	5.00	0.00	0.94	4.06	33.63	33.63
3	---RW-95	1.10	4.79	0.00	1.06	3.73	33.63	33.63
4	---RW-95	1.54	4.58	0.00	1.21	3.37	33.63	33.63
5	---RW-95	1.98	3.00	0.00	1.42	1.58	33.63	33.63
6	---RW-95	2.42	3.00	0.00	1.71	1.29	33.63	33.63
7	---RW-95	2.86	3.00	0.00	2.18	0.82	33.63	33.63
8	---RW-95	3.30	3.00	0.00	3.00	0.00	32.19	32.19 (*)
9	---RW-95	3.74	3.00	0.00	3.00	0.00	20.57	20.57 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength.

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RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [m]		Exit Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	2.90	4.62	-6.92	0.02	-3.11	4.67	6.02	9.27	
2	3.61	4.62	-7.01	0.10	-2.69	4.68	6.30	3.53	
3	4.32	4.62	-5.54	0.02	-1.72	4.69	6.04	2.77	
4	5.03	4.62	-5.63	0.10	-1.29	4.70	6.32	2.12	
5	5.74	4.62	-4.22	0.06	-0.32	4.71	6.06	1.74	
6	6.45	4.62	-4.17	0.02	-0.26	5.55	6.77	1.57	
. 7	7.16	4.62	-4.23	0.07	0.13	5.67	7.10	1.47 .	OK
8	7.87	4.62	-4.84	0.01	-0.22	7.10	8.46	1.47	
9	8.58	4.62	-5.54	0.02	-0.33	7.99	9.53	1.52	
10	9.29	4.62	-5.63	0.06	-0.32	9.38	10.73	1.59	
11	10.00	4.62	-6.32	0.05	-0.68	11.34	12.62	1.67	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points).

Exit Point #	Exit Point (X, Y) [m]		Entry Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	-7.03	0.09	7.87	4.62	-1.23	7.80	9.64	1.53	
2	-6.23	0.01	7.87	4.62	-1.03	7.98	9.51	1.50	
3	-5.61	0.07	7.87	4.62	-0.44	6.99	8.64	1.48	
4	-4.90	0.05	7.16	4.62	-0.22	5.90	7.49	1.47	
. 5	-4.23	0.07	7.16	4.62	0.13	5.67	7.10	1.47 .	OK
6	-3.53	0.06	7.16	4.62	0.38	5.69	6.86	1.48	
7	-2.81	0.03	7.16	4.62	0.70	5.54	6.53	1.52	
8	-2.16	0.06	7.16	4.62	1.13	5.13	6.05	1.58	
9	-1.47	0.04	7.16	4.62	0.98	5.84	6.30	1.66	
10	-0.74	0.01	7.16	4.62	1.12	5.91	6.18	1.77	
11	-0.00	0.00	7.16	4.62	0.26	7.46	7.46	1.86	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

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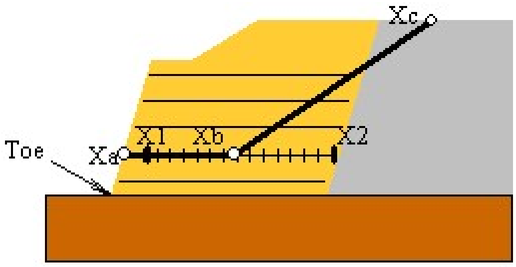
RESULTS OF TRANSLATIONAL ANALYSIS



Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [m]	(Xa, Ya) [m]		(Xb, Yb) [m]		(Xc, Yc) [m]		Fs	STATUS
At toe elevation	0.00	0.00	0.00	0.20	0.00	6.80	4.62	1.48	Minimum on Edge
Reinf. Layer #1	0.22	0.02	0.22	0.10	0.22	6.38	4.62	1.59	Minimum on Edge
Reinf. Layer #2	0.66	0.05	0.66	4.01	0.66	7.22	4.62	1.61	OK
Reinf. Layer #3	1.10	0.08	1.10	3.95	1.10	7.23	4.62	1.58	OK
Reinf. Layer #4	1.54	0.11	1.54	3.79	1.54	7.09	4.62	1.55	OK
. Reinf. Layer #5	1.98	0.14	1.98	3.09	1.98	6.13	4.62	1.47	Minimum on Edge
Reinf. Layer #6	2.42	0.17	2.42	3.19	2.42	5.91	4.62	1.52	Minimum on Edge
Reinf. Layer #7	2.86	0.20	2.86	3.19	2.86	5.36	4.62	1.61	Minimum on Edge
Reinf. Layer #8	3.30	0.23	3.30	3.19	3.30	5.08	4.62	1.76	Minimum on Edge
Reinf. Layer #9	3.74	0.26	3.74	3.29	3.74	4.75	4.62	1.97	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

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CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.47

Critical Circle: Xc = 0.13[m], Yc = 5.67[m], R = 7.10[m]. (Number of slices used = 58)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

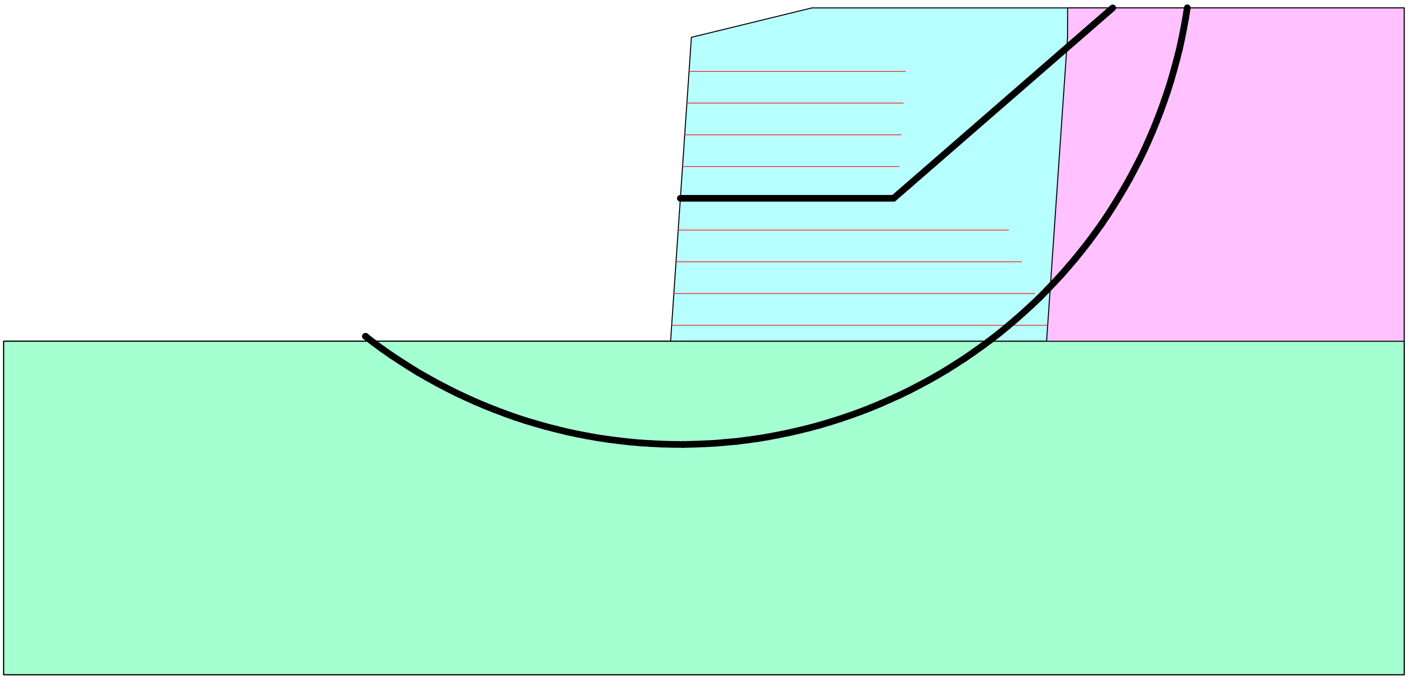
Minimum Factor of Safety = 1.47

Critical Two-Part Wedge: (Xa = 0.14, Ya = 1.98) [m]
(Xb = 3.09, Yb = 1.98) [m]
(Xc = 6.13, Yc = 4.62) [m]
(Number of slices used = 30)
Interslice resultant force inclination = 25.52 [degrees]

Three-Part Wedge Stability Analysis

N O T C O N D U C T E D

REINFORCEMENT LAYOUT: DRAWING



SCALE:

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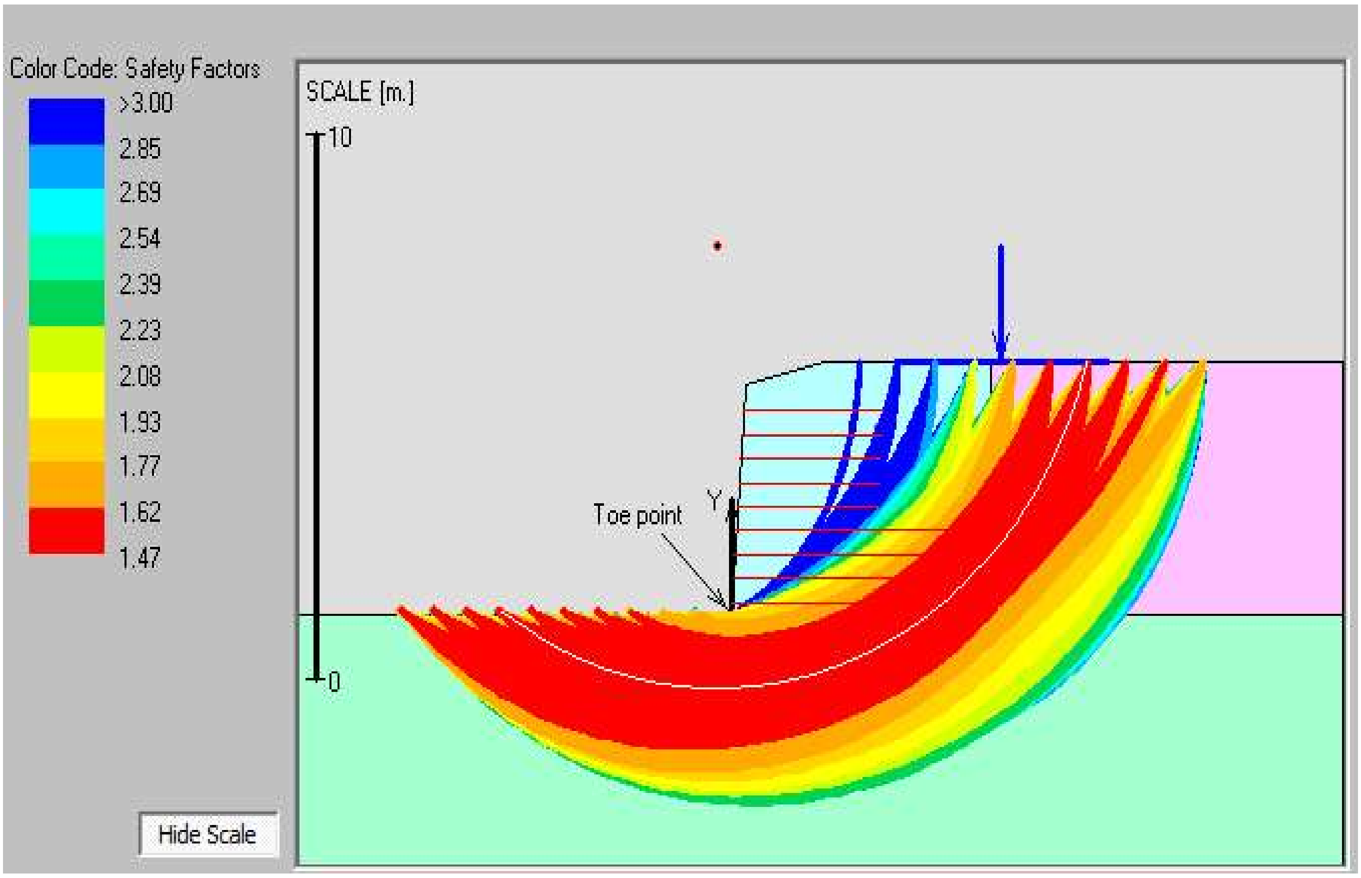
SAFETY MAP: BISHOP ROTATIONAL ANALYSIS MODE



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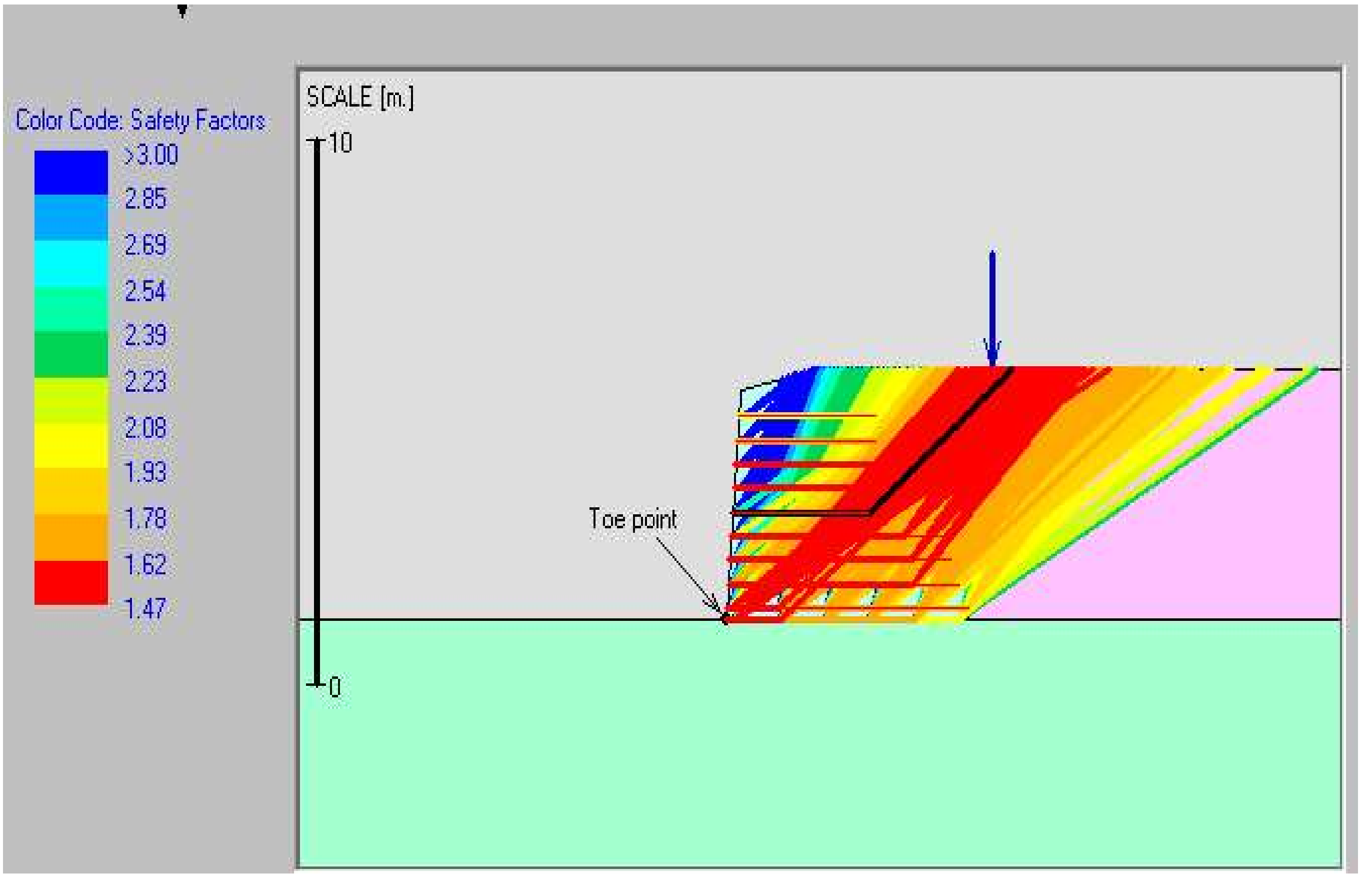
SAFETY MAP: SPENCER TRANSLATIONAL, 2-PART WEDGE



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77+325 overall stability(seismicity)

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PROJECT IDENTIFICATION

Title:	77+325 overall stability(seismicity)
Project Number:	-
Client:	
Designer:	戴征杰（BOSTD）

Description:

Company's information:

Name:	China Railway Design Corporation Serbia Ogranak Beogrda
Street:	Koste Racina 16b, 11000 Belgrade, Serbia ,
Telephone #:	
Fax #:	
E-Mail:	

Original file path and name:
Original date and time of creating this file: Thu Apr 08 11:48:52 2021

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

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INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [kN/m^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [kPa]
1....... Reinforced Soil.................................	19.5	33.0	0.0
2....... Retained Soil.....................................	19.5	30.0	0.0
3....... Foundation Soil.................................	18.5	31.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [kN/m]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Additional Reduction Factor, RFa	Coverage Ratio, Rc
1	---RW-95	95.70	1.16	1.10	2.23	1.00	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
1	---RW-95	0.77	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Horizontal peak ground acceleration coefficient, Ao = 0.140
Design horizontal seismic coefficient, kh = Am = 0.50 x Ao = 0.070 & design vertical seismic coefficient, kv (down) = 0.000 x kh = 0.000

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DRAWING OF SPECIFIED GEOMETRY - GENERAL - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

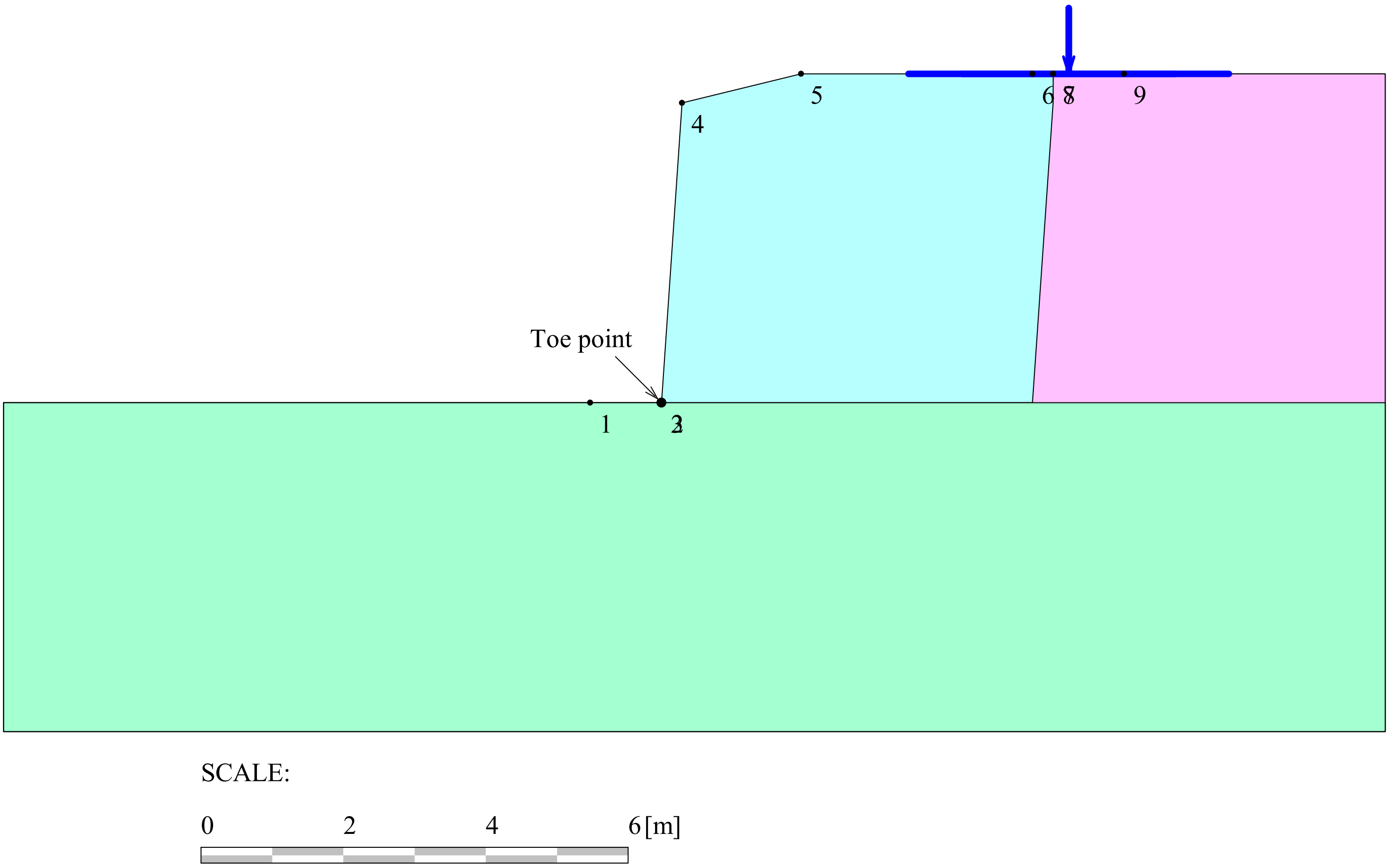
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Surcharge load, Q1....................................None
Surcharge load, Q2....................................None
Surcharge load, Q3....................................None

STRIP LOAD

Strip Load #1.. 12.50 [kPa] Width of base, b = 4.50 [m] Distance from toe point, d = 5.72 [m]
Strip Load #2.. 52.00 [kPa] Width of base, b = 3.00 [m] Distance from toe point, d = 5.72 [m]



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TABULATED DETAILS OF GEMERAL SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

	#	Xi	Yi
Top of Layer 1	1	-1.00	0.00
	2	-0.00	0.00
	3	0.00	0.00
	4	0.29	4.21
	5	1.96	4.62
Top of Layer 2	6	-1.00	0.00
	7	-0.00	0.00
	8	0.00	0.00
	9	5.21	0.00
	10	5.50	4.21
	11	5.50	4.62
	12	6.50	4.62
Top of Layer 3	13	-1.00	0.00
	14	-0.00	0.00
	15	0.00	0.00

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TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [m.]

#	X	Y1	Y2	Y3
1	-1.00	0.00	0.00	0.00
2	-0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.29	4.21	0.00	0.00
5	1.96	4.62	0.00	0.00
6	5.21	4.62	0.00	0.00
7	5.50	4.62	4.21	0.00
8	5.50	4.62	4.62	0.00
9	6.50	4.62	4.62	0.00

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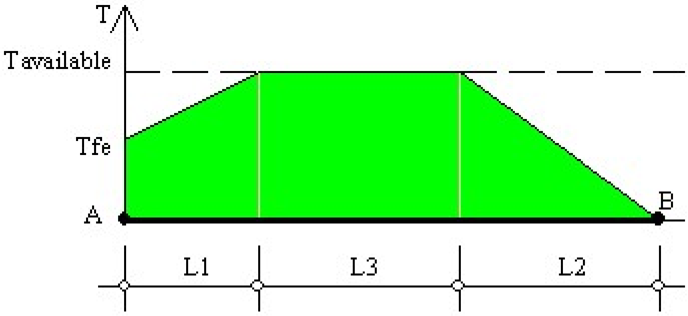
DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER



A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [m]	L [m]	L1 [m]	L2 [m]	L3 [m]	Tfe [kN/m]	Tavailable [kN/m]
1	---RW-95	0.22	5.21	0.00	0.85	4.36	33.63	33.63
2	---RW-95	0.66	5.00	0.00	0.94	4.06	33.63	33.63
3	---RW-95	1.10	4.79	0.00	1.06	3.73	33.63	33.63
4	---RW-95	1.54	4.58	0.00	1.21	3.37	33.63	33.63
5	---RW-95	1.98	3.00	0.00	1.42	1.58	33.63	33.63
6	---RW-95	2.42	3.00	0.00	1.71	1.29	33.63	33.63
7	---RW-95	2.86	3.00	0.00	2.18	0.82	33.63	33.63
8	---RW-95	3.30	3.00	0.00	3.00	0.00	32.19	32.19 (*)
9	---RW-95	3.74	3.00	0.00	3.00	0.00	20.57	20.57 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength.

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RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [m]		Exit Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	2.90	4.62	-6.92	0.02	-3.11	4.67	6.02	6.24	
2	3.61	4.62	-7.01	0.10	-2.69	4.68	6.30	2.90	
3	4.32	4.62	-5.54	0.02	-1.72	4.69	6.04	2.38	
4	5.03	4.62	-5.63	0.10	-1.29	4.70	6.32	1.89	
5	5.74	4.62	-4.91	0.06	-0.85	5.29	6.62	1.58	
6	6.45	4.62	-4.84	0.01	-0.56	5.66	7.09	1.43	
7	7.16	4.62	-4.24	0.06	-0.22	6.53	7.62	1.34	
. 8	7.87	4.62	-4.84	0.01	-0.22	7.10	8.46	1.34 .	OK
9	8.58	4.62	-5.54	0.02	-0.33	7.99	9.53	1.37	
10	9.29	4.62	-5.63	0.06	-0.32	9.38	10.73	1.41	
11	10.00	4.62	-6.32	0.05	-0.68	11.34	12.62	1.47	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.)
The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points).

Exit Point #	Exit Point (X, Y) [m]		Entry Point (X, Y) [m]		Critical Circle (Xc, Yc, R) [m]			Fs	STATUS
1	-7.03	0.09	7.87	4.62	-1.23	7.80	9.64	1.37	
2	-6.23	0.01	7.87	4.62	-1.03	7.98	9.51	1.35	
3	-5.62	0.07	7.87	4.62	-0.56	7.35	8.86	1.34	
. 4	-4.84	0.01	7.87	4.62	-0.22	7.10	8.46	1.34 .	OK
5	-4.24	0.06	7.16	4.62	-0.22	6.53	7.62	1.34	
6	-3.54	0.05	7.16	4.62	0.08	6.38	7.29	1.36	
7	-2.81	0.03	7.16	4.62	0.70	5.54	6.53	1.40	
8	-2.16	0.04	7.16	4.62	0.65	6.10	6.68	1.45	
9	-1.47	0.03	7.16	4.62	0.91	5.97	6.39	1.52	
10	-0.74	0.01	7.16	4.62	1.04	6.04	6.28	1.61	
11	-0.00	0.00	7.16	4.62	0.26	7.46	7.46	1.67	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

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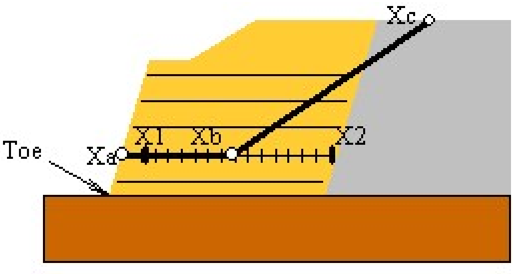
RESULTS OF TRANSLATIONAL ANALYSIS



Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [m]	(Xa, Ya) [m]		(Xb, Yb) [m]		(Xc, Yc) [m]		Fs	STATUS
At toe elevation	0.00	0.00	0.00	0.20	0.00	6.80	4.62	1.38	Minimum on Edge
Reinf. Layer #1	0.22	0.02	0.22	4.17	0.22	7.86	4.62	1.44	OK
Reinf. Layer #2	0.66	0.05	0.66	4.01	0.66	7.22	4.62	1.43	OK
Reinf. Layer #3	1.10	0.08	1.10	3.95	1.10	7.23	4.62	1.41	OK
Reinf. Layer #4	1.54	0.11	1.54	3.79	1.54	6.98	4.62	1.39	OK
. Reinf. Layer #5	1.98	0.14	1.98	3.09	1.98	6.13	4.62	1.30	Minimum on Edge
Reinf. Layer #6	2.42	0.17	2.42	3.19	2.42	5.72	4.62	1.35	Minimum on Edge
Reinf. Layer #7	2.86	0.20	2.86	3.19	2.86	5.29	4.62	1.42	Minimum on Edge
Reinf. Layer #8	3.30	0.23	3.30	3.19	3.30	4.94	4.62	1.54	Minimum on Edge
Reinf. Layer #9	3.74	0.26	3.74	3.29	3.74	4.65	4.62	1.71	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

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Version 3.0 ReSSA Version 3.0 ReSSA Version 3.0 ReSSA

2/4.1.6.2 ПРЕДМЕР И ПРЕДРАЧУН РАДОВА

2/4. 1.6.2 Зид од армиране земље у станици Нови Сад (km77+000 ~ km77+325)

Бр.	Опис радова	Јединица мере	Количина	Јединична цена(дин)	Цена (дин)
			A	B	AxB
01.00	**ПРИПРЕМНИ РАДОВИ**				
01.01	Припремни радови: Радови укључују геодетска мерења, пренос пројектних података на терен, постављање, ажурирање и стабилизацију ознака током периода изградње и прелиминарног пуштања у рад. Ова ставка такође укључује испоруку материјала за горе поменуто и чишћење ситног грмља на земљи. Радови ове позиције биће плаћени паушално.			350.000,00	350.000,00
				УКУПНО ПРИПРЕМНИХ РАДОВА:	**350.000,00**
02.00	**ЗЕМЉАНИ РАДОВИ**				
02.01	**Ископ земље за изградњу темеља потпорног зида** Ова позиција укључује ископ земљишта 2 и 3 категорије, утовар и одвоз вишка материјала на подручје удаљености до 500 м према упутству инжењера. Мерење ископа треба вршити надоле од нивоа нетакнутог тла. Мерење по m3 ископаног материјала.	m^3	5.927,00	850,00	5.037.950,00
02.02	**Завршно темељно тло (подтло) у подручју носеће конструкције.** Позиција укључује сабијање, откривање ради сушења или влажења нетакнутог тла у зони носеће конструкције и на месту темеља насипа. Сабијање се наставља све док модул горњег слоја не буде Evd=20MPa. Цена покрива контролна мерења сабијања и подношење сертификата коју издаје акредитована лабораторија. Мерење по м2 завршног темељног тла.	m^2	2.581,00	65,00	167.765,00

Бр.	Опис радова	Јединица мере	Количина	Јединична цена(дин)	Цена (дин)
			A	B	AxB
02.03	**Обрада темеља: пуњење песком и шљунком** Позиција укључује набавку, испоруку и пуњење паковања песка и шљунка. У паковање се уноси 0/63 песак и шљунак, сабијених на Evd = 30MPa. Мерење по m3 материјала за пуњење.	m^3	1.386,00	2.050,00	2.841.300,00
02.04	**Насипање насипа у зони геомреже** Позиција укључује набавку, испоруку и пуњење материјала у зонама геомреже. Пуњење насипа треба да буде са песком и шљунком 0/63, однос тежине мањи од 75μm је <12%, а коефицијент униформности Cu > 6. Да би се постигла најбоља адхезија између насипа и геомреже, дебљина сваког збијеног слоја је 22 cm, Ev2 треба да буде једнак 45 MN/ m2 у прва 2 метра висине насипа и минимални степен сабијања између 3. метра насипа и врх насипа треба да задовољава Ev2= 60 MN / м2. Мерење по m3 материјала за пуњење.	m^3	6.186,00	2.050,00	12.681.300,00
02.05	**Пуњење лесом (глином) темељне јаме ван зида** Ова позиција обухвата затрпавање од слоја за обраду подтла иза зида до темељне јаме на пројектованом тлу. Ископано земљиште се користи као пунило, а дренажни нагиб од најмање 5% постављен је изван зида. Мерење по м3 материјала за пуњење.	m^3	284,00	1.000,00	284.000,00
				УКУПНО ЗЕМЉАНИХ РАДОВА:	**21.012.315,00**

Бр.	Опис радова	Јединица мере	Количина	Јединична цена(дин)	Цена (дин)
			A	B	AxB
03.00	**БЕТОНИРАЊЕ**				
03.01	**Изливање С12 / 15 бетонског тампонског слоја за темељ** Изливање неармираног бетона испод темеља у облику слова L, С12 / 15, дебљине 10 cm Мерење по m3 изливеног бетона.	m^3	27,50	10.000,00	275.000,00
03.02	**Темељи бетона С30/37** Позиција укључује набавку, испоруку материјала, рад за мешање и постављане бетона, сертификат о квалитету и друге радове. Мерење по m3 изливеног бетона.	m^3	72,00	18.000,00	1.296.000,00
03.03	**Изградa сегментних блок зидних плоча, класа бетона С30 / 37, V-I, М150** У цену је урачуната куповина, испорука и израда сегментних блок зидних плоча. Пројектна величина монтажног блока је 400 × 220 × 220 мм, а класа бетона је С30 / 37, V-I, М150. Мерење по m2 уграђених зидних плоча	m^2	1.080,00	7.800,00	8.424.000,00
03.04	**Круна за ливење од бетона С30/37** Позиција укључује набавку, испоруку материјала, мешање и постављање (изливање) бетона у зидну круну, сертификат о квалитету и друге радове. Зидна круна је изливена од бетона класе С30 / 37, V-I, М150, у потпуности према пројекту. Мерење по m3 изливеног бетона.	m^3	60,00	20.000,00	1.200.000,00
				УКУПНО ЗА БЕТОНСКЕ РАДОВЕ:	**11.195.000,00**

Бр.	Опис радова	Јединица мере	Количина	Јединична цена(дин)	Цена (дин)
			A	B	AxB
04.00	**АРМАТУРА**				
04.01	**Ребраста арматура Б500б** Набавка, транспорт, сечење, савијање и учвршћивање арматуре Б500Б у зид темеља. Мерење по кг фиксираних арматура.	kg	4.529,00	125,00	566.125,00
04.02	**Ребраста арматура Б500б** Набавка, транспорт, сечење, савијање и учвршћивање арматуре Б500Б у круну зида темеља. Мерење по кг фиксираних арматура.	kg	5.239,00	125,00	654.875,00
				УКУПНО ЗА АРМАТУРУ:	**1.221.000,00**
05.00	**ГЕОСИНТЕТИКА**				
05.01	**Полагање аксијалне ХДПЕ геомреже** Цена укључује набавку, сечење и полагање аксијалних HDPE геомрежа према пројектном цртежу. Затезна чврстоћа геомреже треба да задовољава пројектне захтеве следећим условима: пројектована температура 20 °C, радни век пројекта је 120 година, деформација пузања након изградње не већа од 1%. Вредности T_{CR} и T_{CS} морају бити наведени BBA сертификатом. Мерење по m2 положене геомреже. RW-95:T_{CR}≥42.5 ,T_{CS}≥18kN/m	m^2	14.246,00	600,00	8.547.600,00
	RW-125:T_{CR}≥55.5,T_{CS}≥24kN/m	m^2		750,00	0,00
				УКУПНО ЗА ГЕОСИНТЕТИКУ:	**8.547.600,00**
06.00	**ДРЕНАЖА**				
06.01	**Дренажа шљунка иза зида** У цену је урачуната куповина и полагање материјала од слоја шљунчаног филтера, а величина честица пунила филтарског слоја је 16/32. Мерење по м3 постављеног шљунка.	m^3	541,00	2.800,00	1.514.800,00

Бр.	Опис радова	Јединица мере	Количина	Јединична цена(дин)	Цена (дин)
			A	B	AxB
06.02	**Полагање слоја геотекстилног филтера** У цену је урачуната куповина и полагање нетканог пропустљивог геотекстила (300 g / m2). Мерење по m2 постављеног геотекстила.	m^2	2.282,00	320,00	730.240,00
				УКУПНО ДРЕНАЖНИ РАДОВИ:	**2.245.040,00**
07.00	**ОСТАЛО**				
07.01	**Заштитна ограда на круни зида** Позиција укључује набавку, транспорт и поправљање заштитне ограде на круни зида. Мерење по m фиксиране ограде.	m	150,00	12.000,00	1.800.000,00
				УКУПНО ОСТАЛО:	**1.800.000,00**

РЕКАПИТУЛАЦИЈА		
01.00	**ПРИПРЕМНИ РАДОВИ**	**350.000,00**
02.00	**ЗЕМЉАНИ РАДОВИ**	**21.012.315,00**
03.00	**БЕТОНИРАЊЕ**	**11.195.000,00**
04.00	**АРМАТУРА**	**1.221.000,00**
05.00	**ГЕОСИНТЕТИКА**	**8.547.600,00**
06.00	**ДРЕНАЖА**	**2.245.040,00**
07.00	**ОСТАЛО**	**1.800.000,00**
	УКУПНО (Дин):	**46.370.955,00**

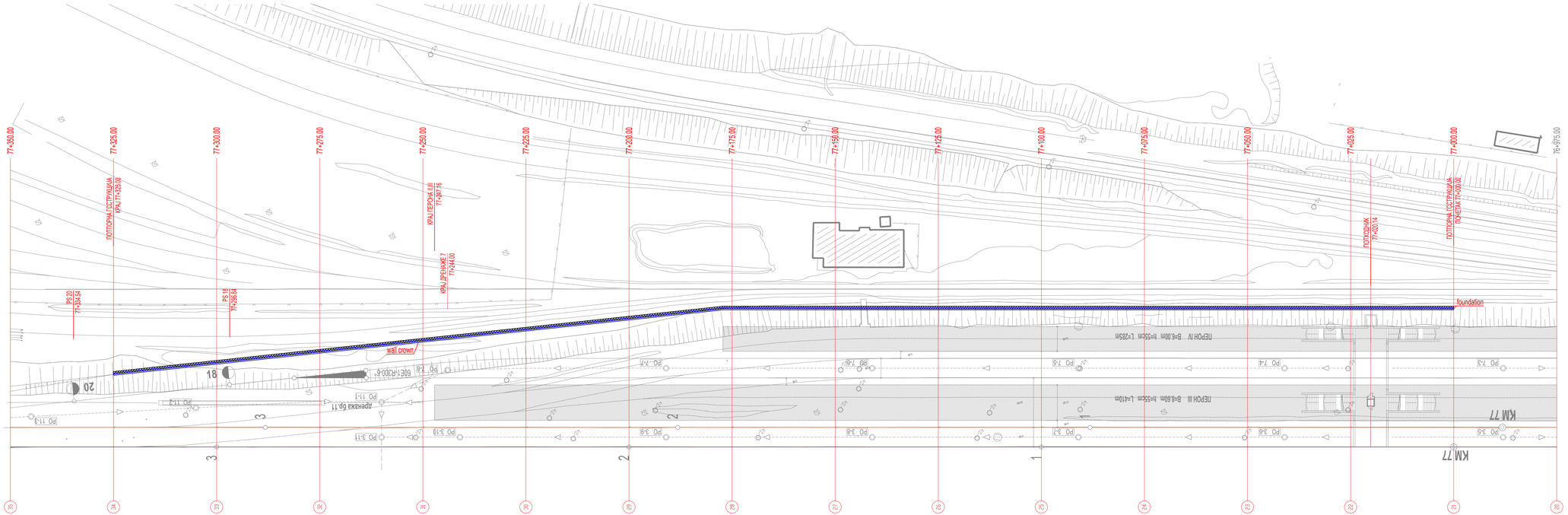
Belgrade, April 2021

Responsible Design Engineer:

Зоран Луковић, дипл.грађ.инж

license No.: 310 3032 03

2/4.1.7 ГРАФИЧКА ДОКУМЕНТАЦИЈА



Број/Number	Датум / Date	Опис / Description
03		
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia
Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант: / Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број: / license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд, / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
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No.10, Fuxing Road,Haidian District,Beijing
P.R China, 100844

Chico Communication Construction Company Ltd. (CCCC)
No.85, Dashanghuamei Street,Xicheng District,Beijing
P.R China, 100088

Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

Део пројекта / Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000 ~ km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000 ~ km77+325)

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

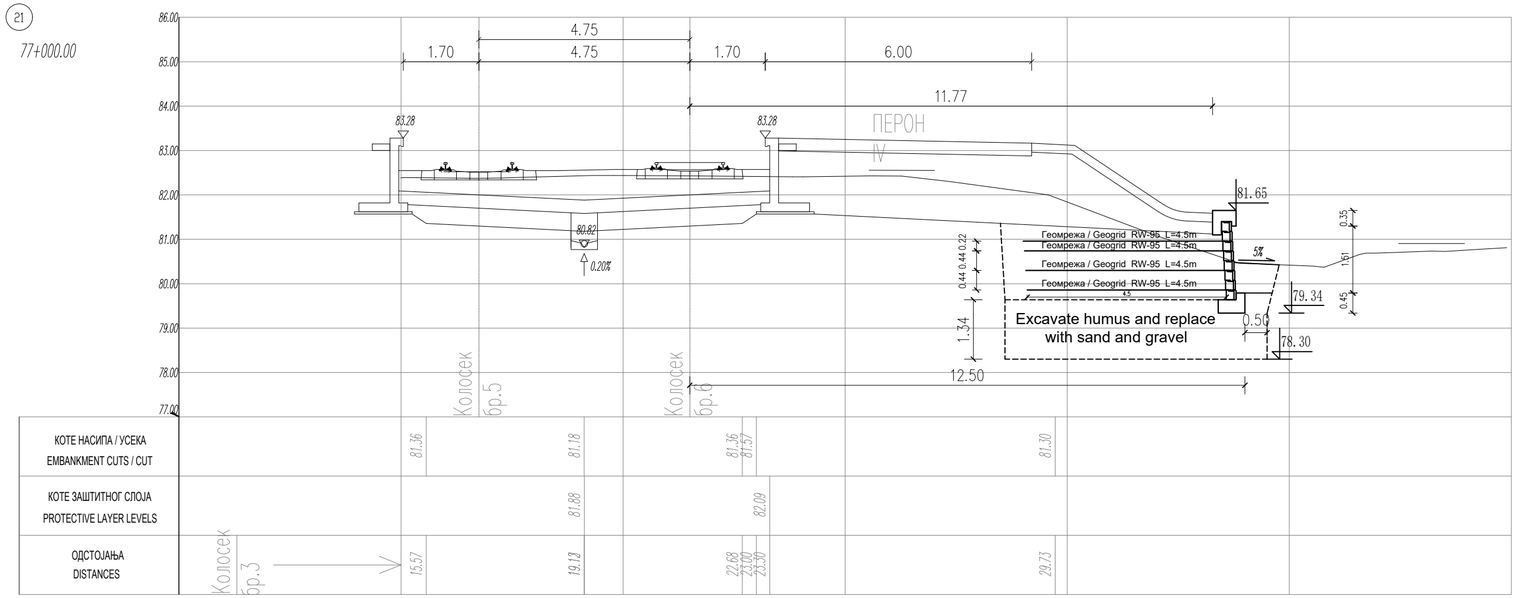
Цртеж: / Drawing:
СИТУАЦИЈА/Layout drawing

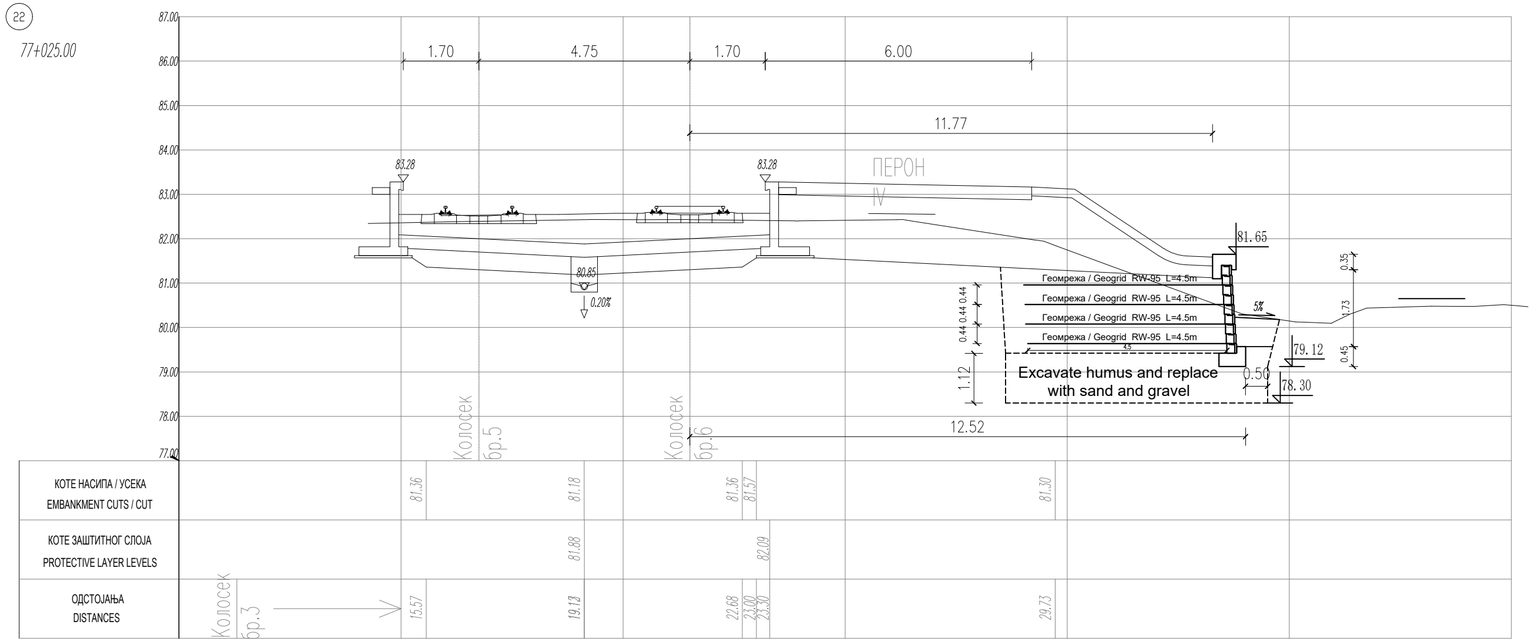
Размера: Scale: 1:500

Врста тех. док: Type of tech. docum.: **ПГД / DCP**

датум/date: **04.2021.**

Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц1**





Description:
This section drawing is only for reinforced soil walls, and the design drawing of the subgrade section shall be subject to 2/2.

Опис:
Овај цртеж пресека односи се само на потпорне зидове од армиране земље, а за пројектни цртеж пресека доњег строја погледати документ 2/2.

Број/Number	Датум / Date	Опис / Description
03		
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
中国铁路国际有限公司 CHINA RAILWAY International Co, Ltd.
China Railway International Corporation Ltd. No.10 Fuxing Road,Haidian District,Beijing P.R China, 100844
CHINA COMMUNICATIONS CONSTRUCTION COMPANY LIMITED
China Communication Construction Company Ltd. (CCCC) No.85 Deshengmenwai Street,Xicheng District,Beijing P.R China, 100088

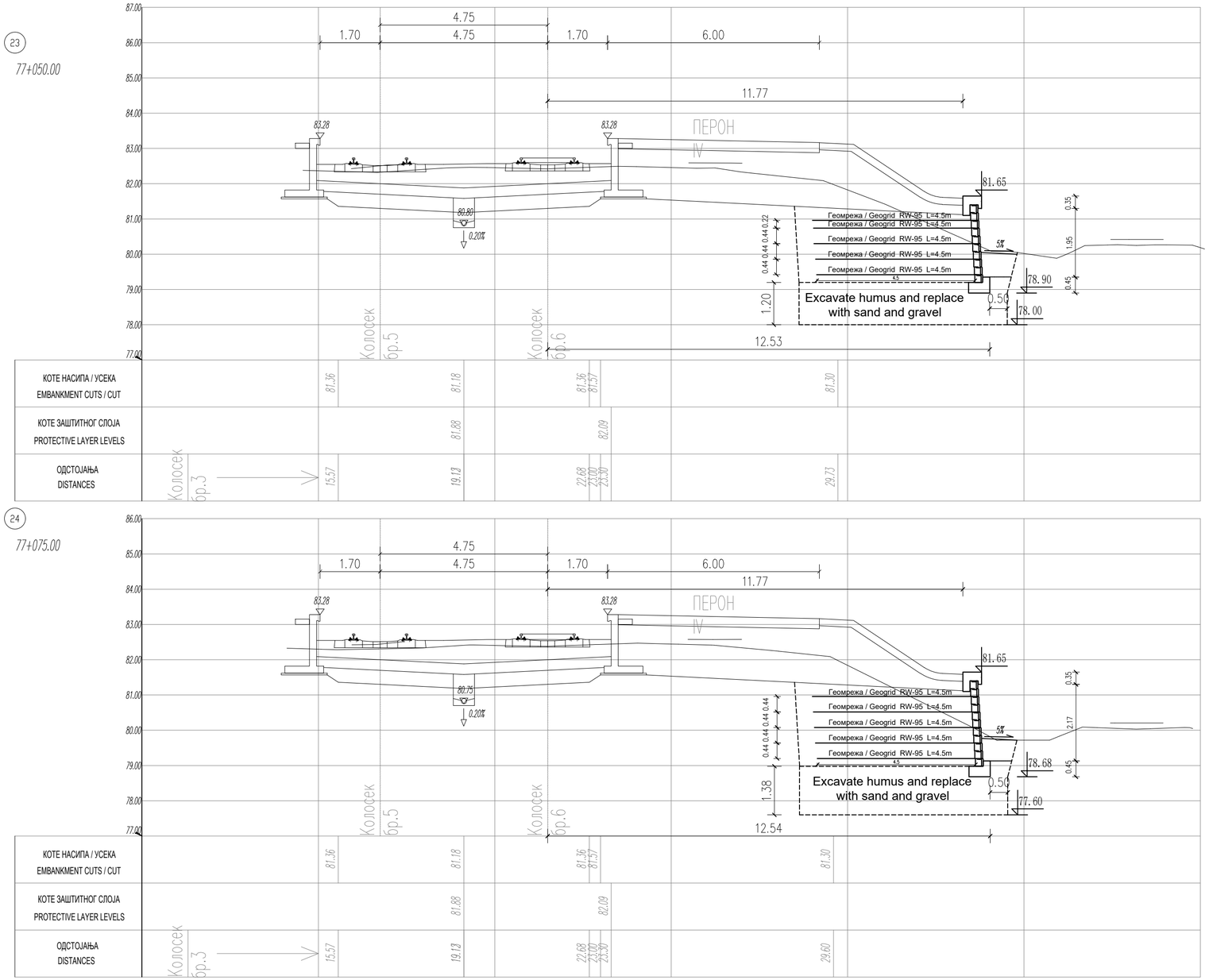
Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

Део пројекта:/ Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000 ~ km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000 ~ km77+325)

Цртеж:/ Drawing:
Попречни пресеци зида од армиране земље
Cross-sections of reinforced earth wall

Размера: Scale: 1:100

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP
датум:/date: **04.2021.**
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц2.1**



Description:
This section drawing is only for reinforced soil walls, and the design drawing of the subgrade section shall be subject to 2/2.

Опис:
Овај цртеж пресека односи се само на потпорне зидове од армиране земље, а за пројектни цртеж пресека доњег строја погледати документ 2/2.

Број/Number	Датум / Date	Опис / Description
03		
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
中国铁路国际有限公司 CHINA RAILWAY International Co, Ltd.
China Railway International Corporation Ltd.
No.10 Fuxing Road,Haidian District,Beijing
P.R China, 100844
CHINA COMMUNICATIONS CONSTRUCTION COMPANY LIMITED
China Communication Construction Company Ltd. (CCCC)
No.85 Deshengmenwai Street,Xicheng District,Beijing
P.R China, 100088

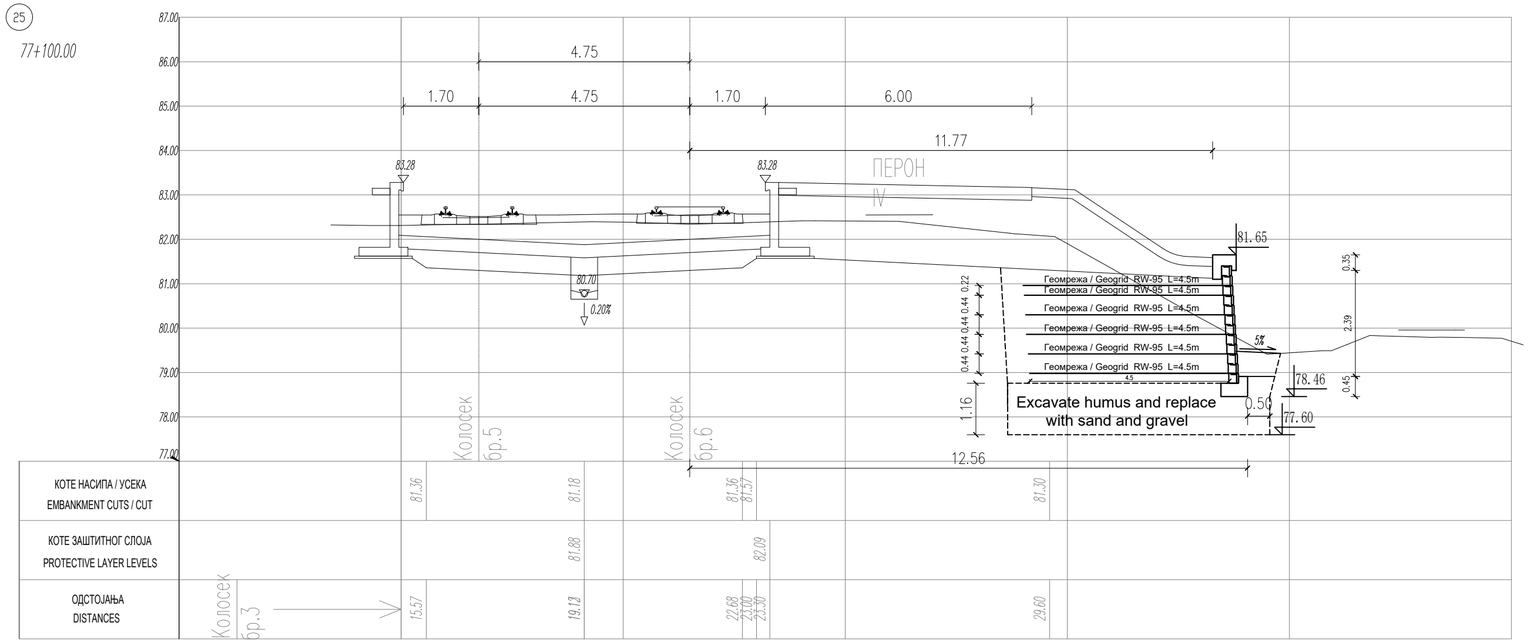
Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

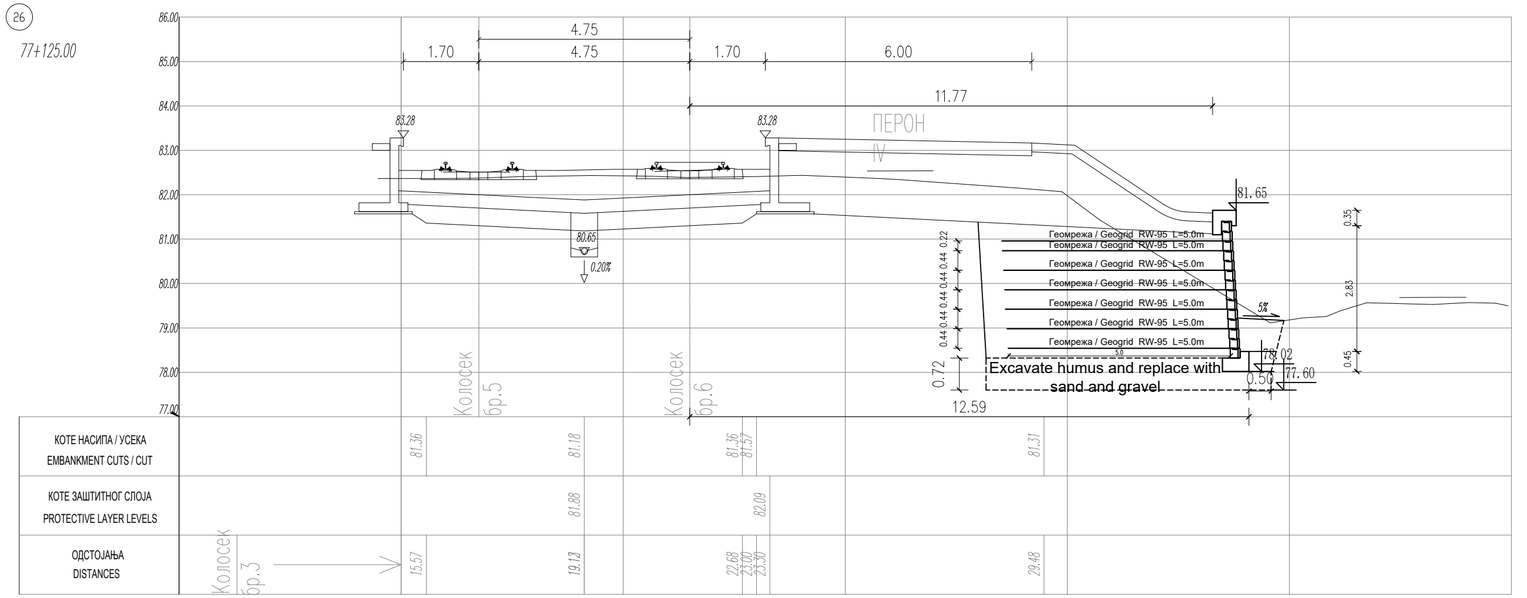
Део пројекта:/ Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000～km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000～km77+325)

Цртеж:/ Drawing:
Попречни пресеци зида од армиране земље
Cross-sections of reinforced earth wall

Размера: Scale: 1:100

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP
датум:/date: **04.2021.**
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц2.2**





Description:
This section drawing is only for reinforced soil walls, and the design drawing of the subgrade section shall be subject to 2/2.

Опис:
Овај цртеж пресека односи се само на потпорне зидове од армиране земље, а за пројектни цртеж пресека доњег строја погледати документ 2/2.

Број/Number	Датум / Date	Опис / Description
03		
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
中国铁路国际有限公司 CHINA RAILWAY International Co, Ltd.
China Railway International Corporation Ltd. No.10 Fuxing Road,Haidian District,Beijing P.R China, 100844
CHINA COMMUNICATIONS CONSTRUCTION COMPANY LIMITED
China Communication Construction Company Ltd. (CCCC) No.85 Deshengmenwai Street,Xicheng District,Beijing P.R China, 100088

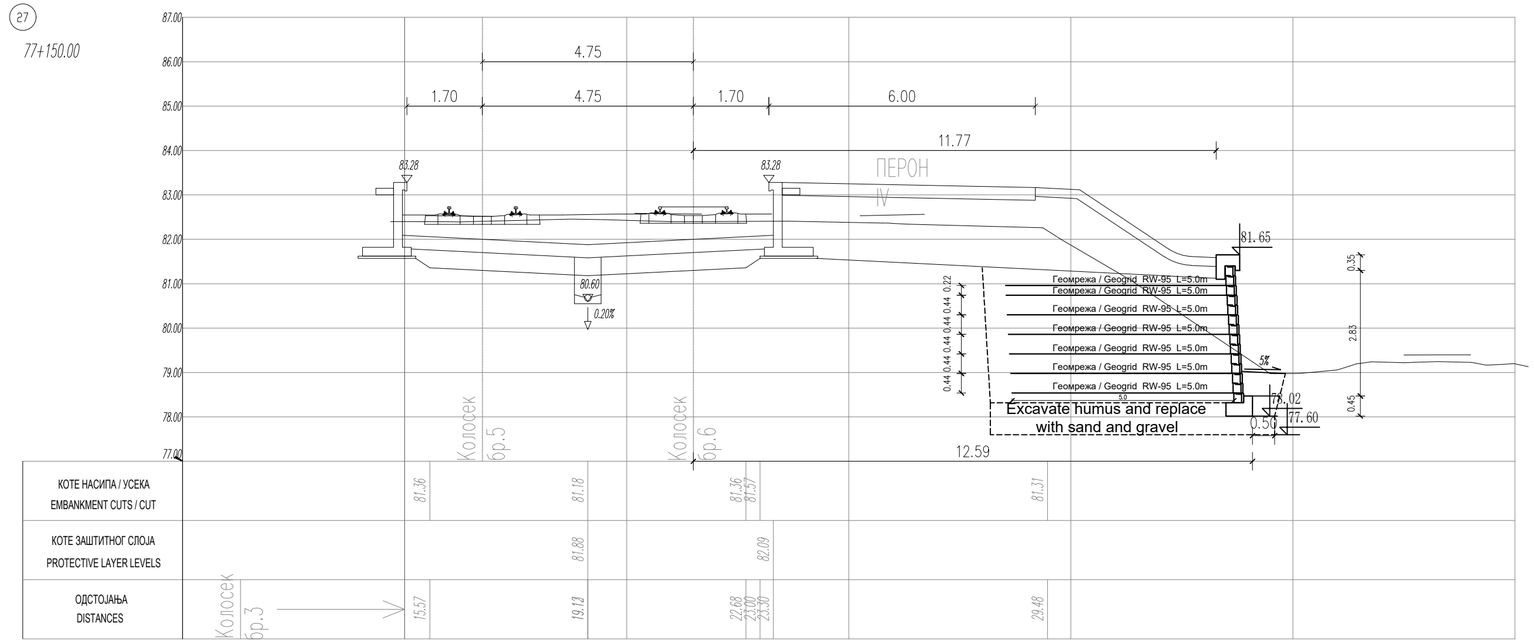
Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

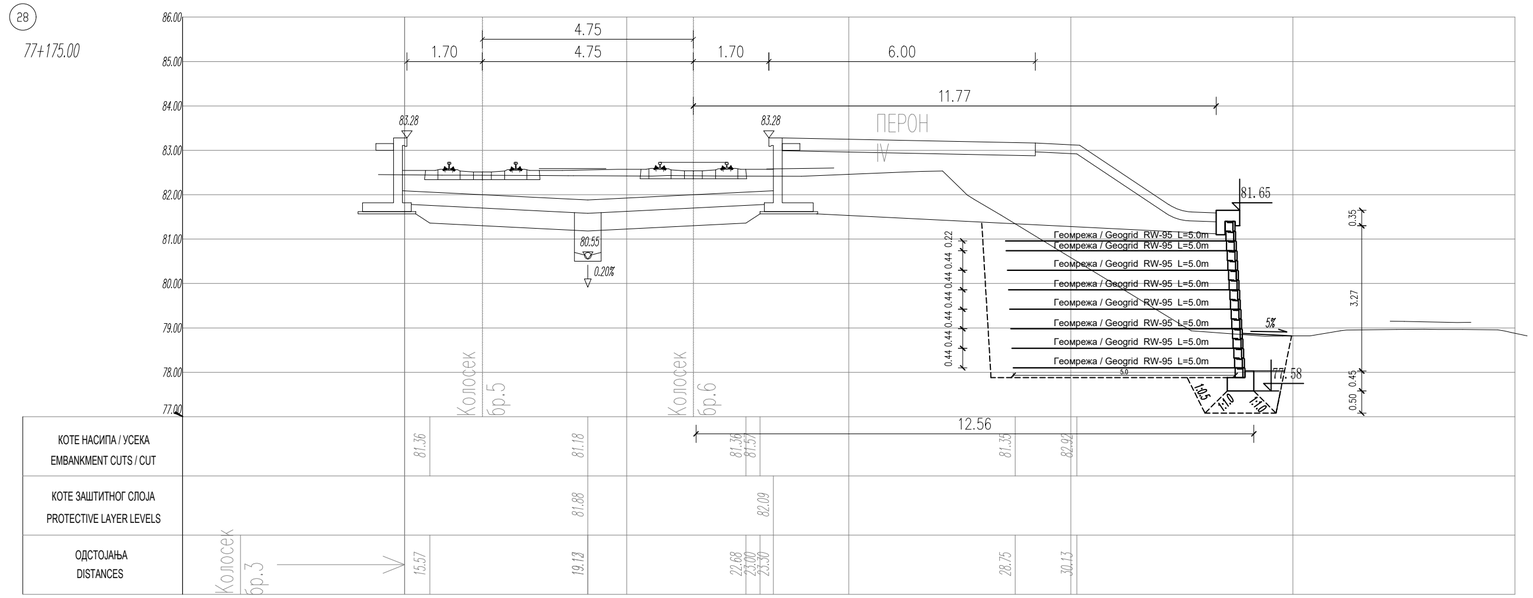
Део пројекта:/ Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000～km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000～km77+325)

Цртеж:/ Drawing:
Попречни пресеци зида од армиране земље
Cross-sections of reinforced earth wall

Размера: Scale: 1:100

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP
датум:/date: **04.2021.**
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц2.3**





Description:
This section drawing is only for reinforced soil walls, and the design drawing of the subgrade section shall be subject to 2/2.

Опис:
Овај цртеж пресека односи се само на потпорне зидове од армиране земље, а за пројектни цртеж пресека доњег строја погледати документ 2/2.

Број/Number	Датум / Date	Опис / Description
03		
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
中国铁路国际有限公司 CHINA RAILWAY International Co, Ltd.
China Railway International Corporation Ltd. No.10 Fuxing Road,Haidian District,Beijing P.R China, 100844
China Communication Construction Company Ltd. (CCCC) No.85 Deshengmenwai Street,Xicheng District,Beijing P.R China, 100088

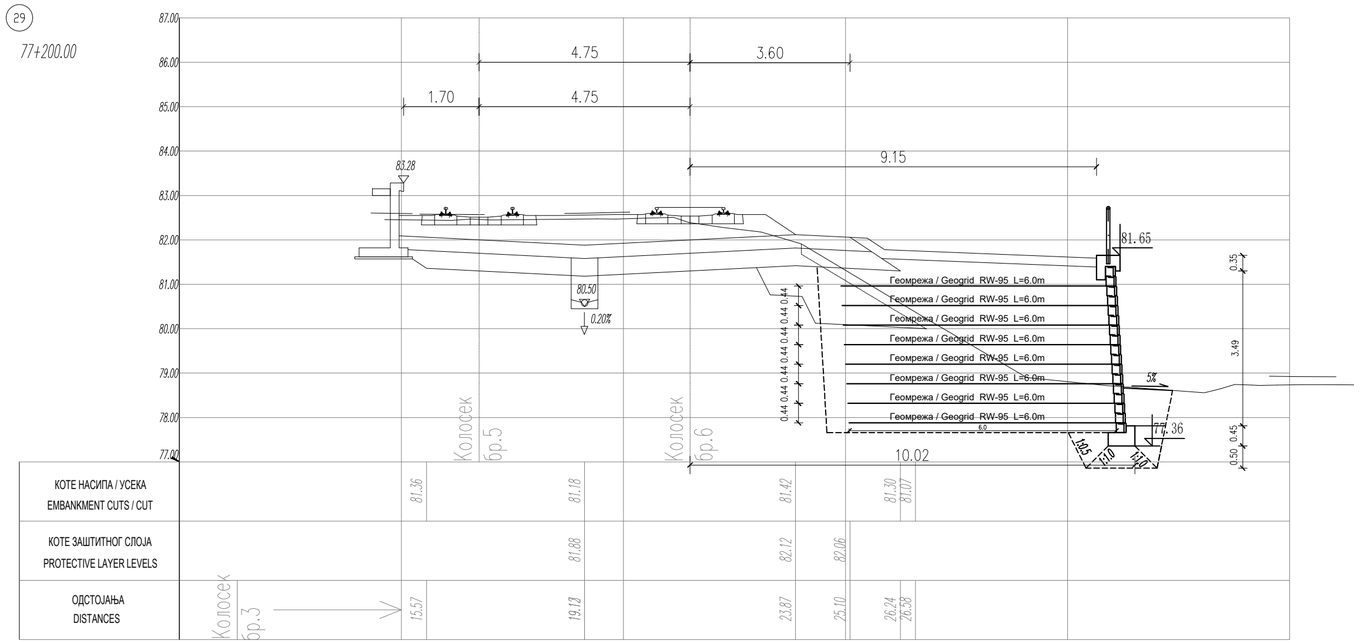
Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

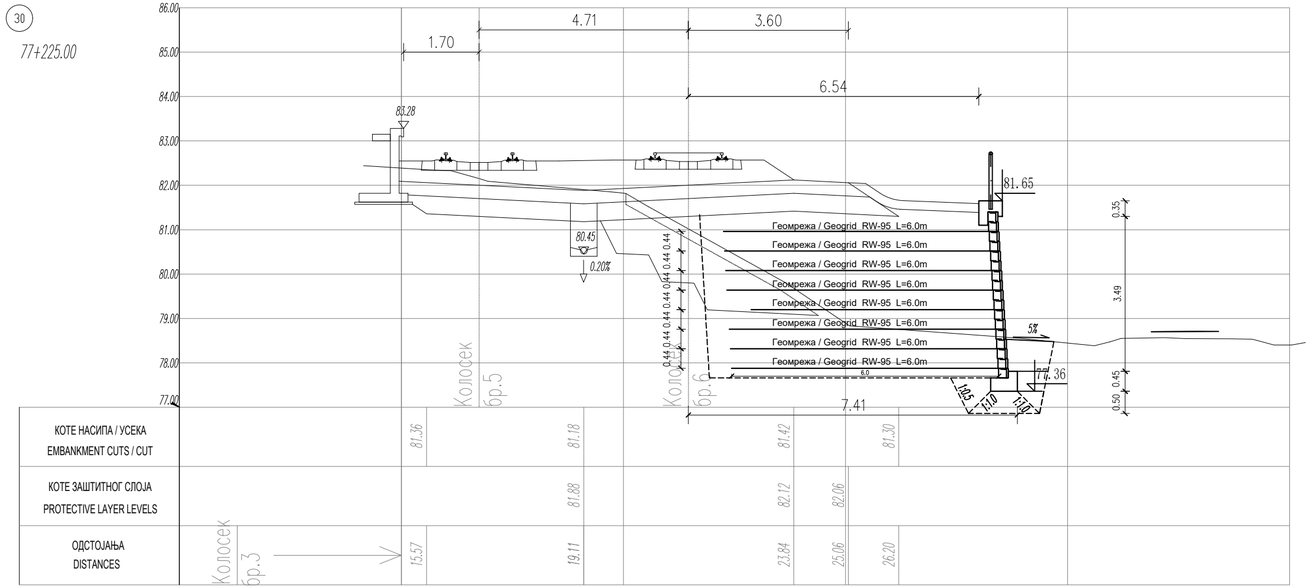
Део пројекта:/ Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000～km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000～km77+325)

Цртеж:/ Drawing:
Попречни пресеци зида од армиране земље
Cross-sections of reinforced earth wall

Размера: Scale: 1:100

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP
датум:/date: **04.2021.**
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц2.4**





Description:
This section drawing is only for reinforced soil walls, and the design drawing of the subgrade section shall be subject to 2/2.

Опис:
Овај цртеж пресека односи се само на потпорне зидове од армиране земље, а за пројектни цртеж пресека доњег строја погледати документ 2/2.

Број/Number	Датум / Date	Опис / Description
03		
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
中国铁路国际有限公司 CHINA RAILWAY International Co, Ltd.
China Railway International Corporation Ltd.
No.10 Fuxing Road,Haidian District,Beijing
P.R China, 100844
CHINA COMMUNICATIONS CONSTRUCTION COMPANY LIMITED
China Communication Construction Company Ltd. (CCCC)
No.85 Deshengmenwai Street,Xicheng District,Beijing
P.R China, 100088

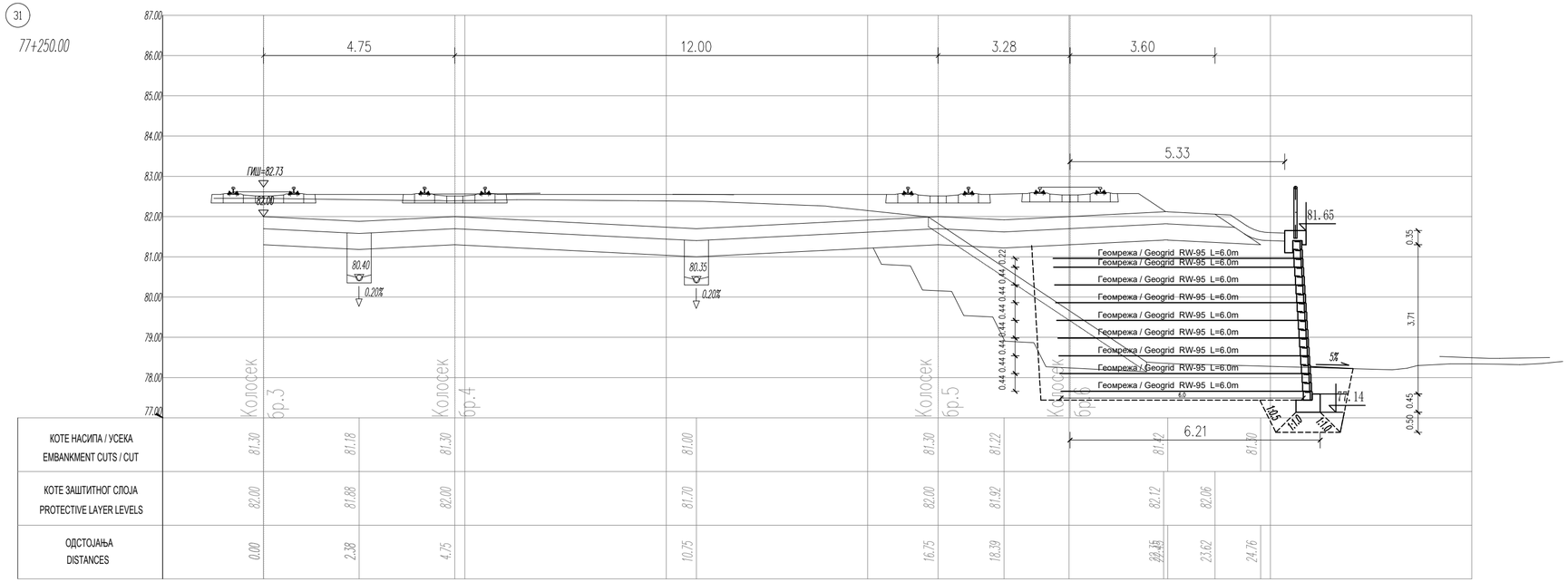
Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

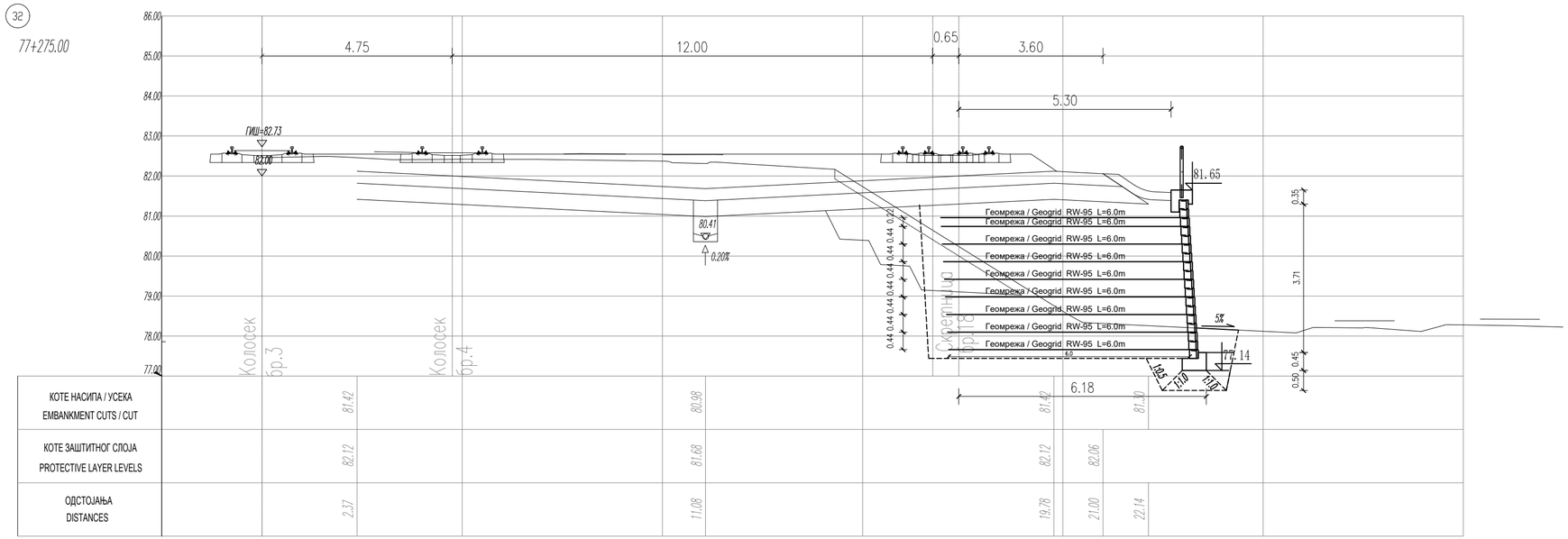
Део пројекта:/ Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000 ÷ km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000 ÷ km77+325)

Цртеж:/ Drawing:
Попречни пресеци зида од армиране земље
Cross-sections of reinforced earth wall

Размера: Scale: 1:100

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP
датум:/date: **04.2021.**
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц2.5**





Description:
This section drawing is only for reinforced soil walls, and the design drawing of the subgrade section shall be subject to 2/2.

Опис:
Овај цртеж пресека односи се само на потпорне зидове од армиране земље, а за пројектни цртеж пресека доњег строја погледати документ 2/2.

Број/Number	Датум / Date	Опис / Description
03		
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
China Railway International Corporation Ltd. No.10 Fuxing Road,Haidian District,Beijing P.R China, 100844
China Communication Construction Company Ltd. (CCCC) No.85 Deshengmenwai Street,Xicheng District,Beijing P.R China, 100088

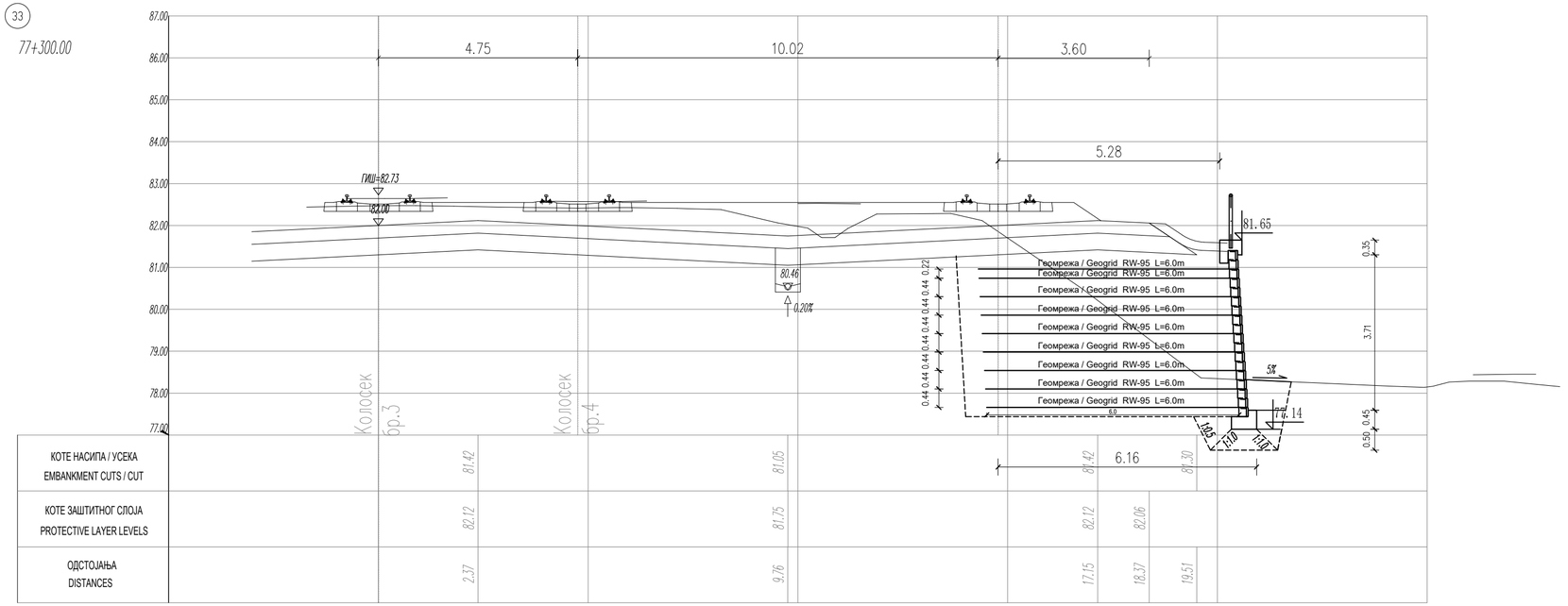
Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

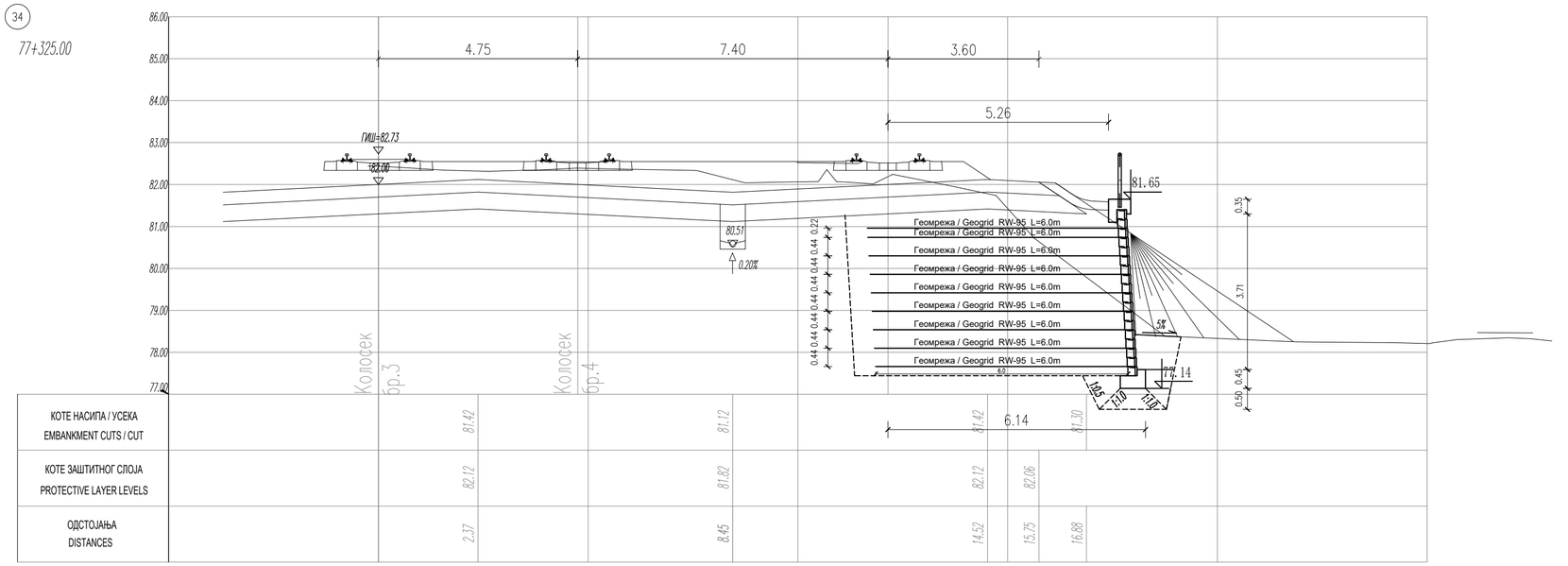
Део пројекта:/ Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000～km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000～km77+325)

Цртеж:/ Drawing:
Попречни пресеци зида од армиране земље
Cross-sections of reinforced earth wall

Размера: Scale: 1:100

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP
датум:/date: **04.2021.**
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц2.6**





Description:
This section drawing is only for reinforced soil walls, and the design drawing of the subgrade section shall be subject to 2/2.

Опис:
Овај цртеж пресека односи се само на потпорне зидове од армиране земље, а за пројектни цртеж пресека доњег строја погледати документ 2/2.

Број/Number	Датум / Date	Опис / Description
03		
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
中国铁路国际有限公司 CHINA RAILWAY International Co, Ltd.
China Railway International Corporation Ltd.
No.10 Fuxing Road,Haidian District,Beijing
P.R China, 100844

CHINA COMMUNICATIONS CONSTRUCTION COMPANY LIMITED
China Communication Construction Company Ltd. (CCCC)
No.85 Deshengmenwai Street,Xicheng District,Beijing
P.R China, 100088

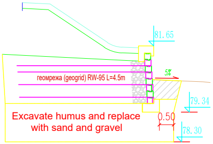
Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

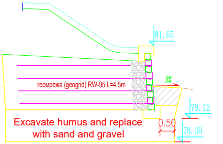
Део пројекта:/ Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000～km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000～km77+325)

Цртеж:/ Drawing:
Попречни пресеци зида од армиране земље
Cross-sections of reinforced earth wall

Размера: Scale: 1:100

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP
датум:/date: **04.2021.**
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц2.7**


81.65
геомрежа (geogrid) RW-95 L=4.5m
5%
79.34
0.50
78.30
Excavate humus and replace with sand and gravel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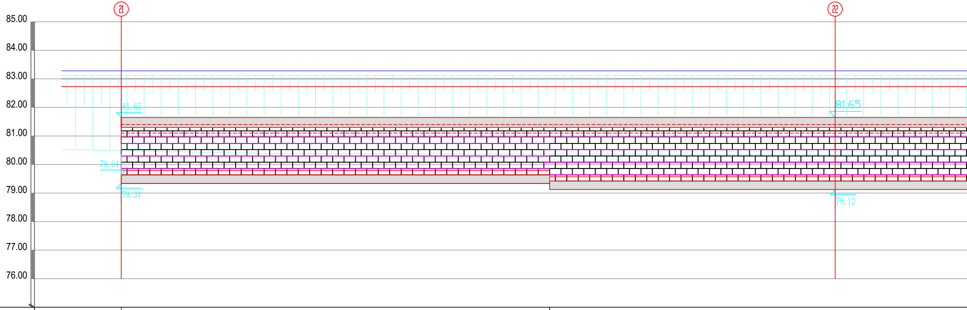
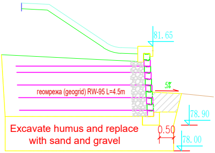
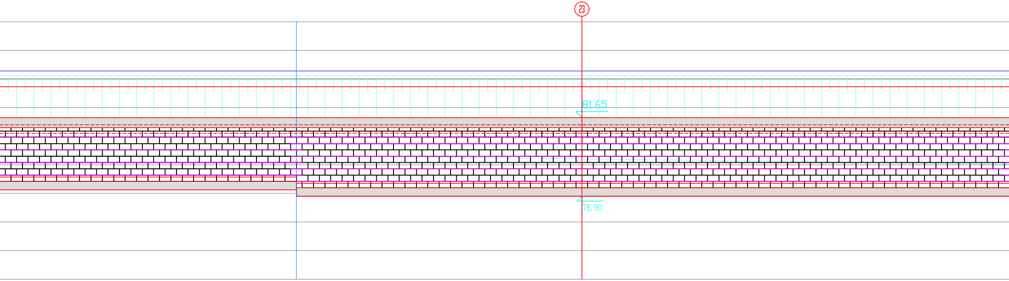
5%
79.12
0.50
78.30
Excavate humus and replace with sand and gravel

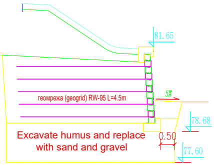

85.00
84.00
83.00
82.00
81.00
80.00
79.00
78.00
77.00
76.00
21
22
81.65
79.64
79.34
81.65
79.12

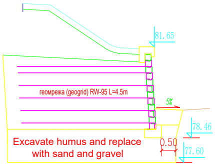
geogrid Геомрежа	RW-95	Layer number × length	4×4.5m	4×4.5m	
	RW-125	Layer number × length			
elevation Кота	Crown at the top of the wall Круна на врху зида		81.65	81.65	81.65
	ground Кота терена		80.40		80.18
	Bottom of foundation Дно темеља		79.34	79.34 79.12	79.12
mileage Стационажа			km77+000	km77+015	km77+025


81.65
5%
геомрежа (geogrid) RW-95 L=4.5m
78.90
0.50
78.00
Excavate humus and replace with sand and gravel


23
81.65
78.90

	5×4.5m	
81.65	81.65	81.65
	79.96	
79.34	78.90 78.90	79.34
km77+040	km77+050	km77+065


81. 65
5%
геомрежа (geogrid) RW-95 L=4.5m
78. 68
Excavate humus and replace with sand and gravel
0.50
77. 60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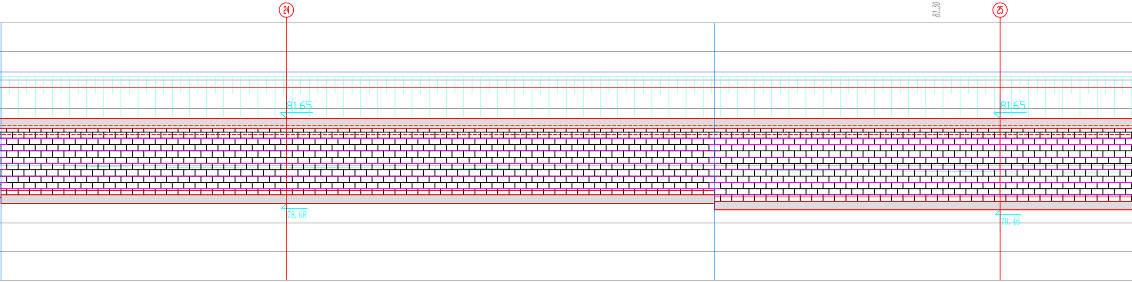
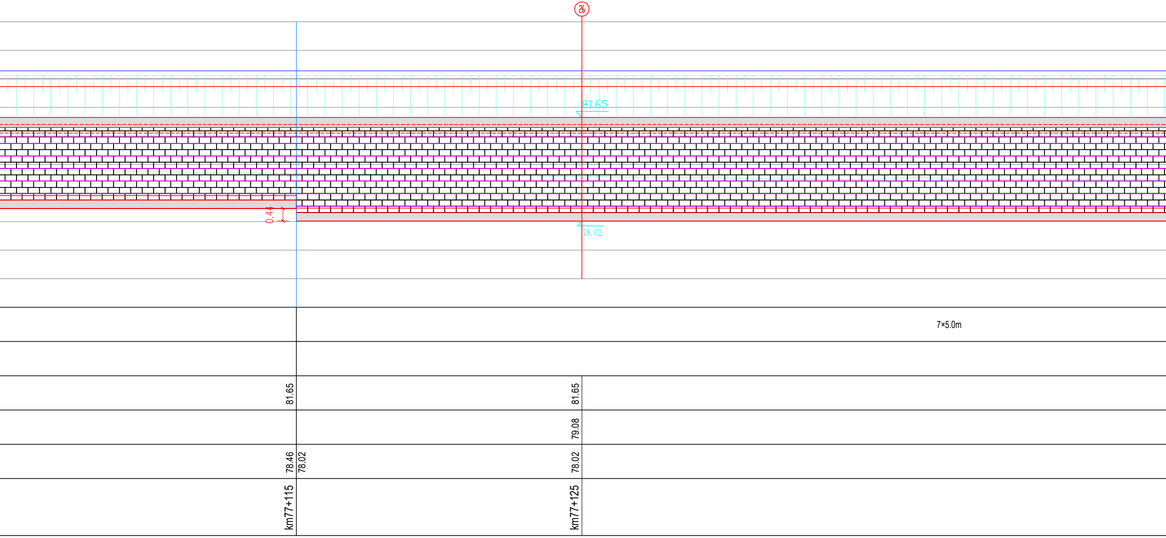
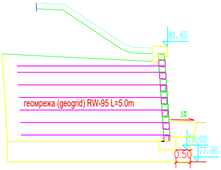
геомрежа (geogrid) RW-95 L=4.5m
5%
78. 46
Excavate humus and replace with sand and gravel
0.50
77. 60


24
81.65
78.68
81.30
25
81.65
78.46

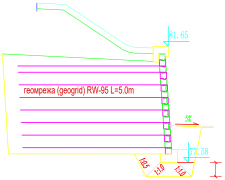
5×4.5m		6×4.5m	
	81.65	81.65	81.65
	79.74		79.52
78.68	78.68	78.68 78.46	78.46
	km77+075	km77+090	km77+100

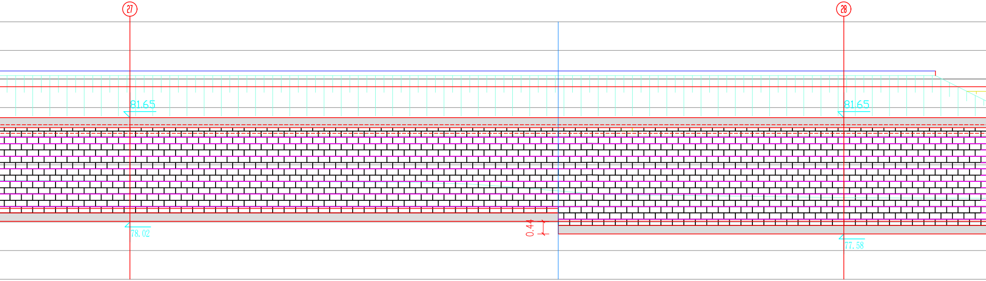

26
81.65
0.44
78.02
7×5.0m
81.65
81.65
79.08
78.46
78.02
78.02
km77+115
km77+125


81.65
геомрежа (geogrid) RW-95 L=5.0m
5%
78.02
77.60
0.50

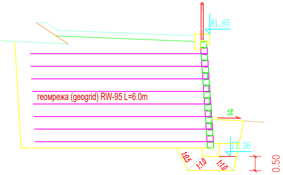
ИЗГЛЕД ЗИДА ОД АРМИРАНЕ ЗЕМЉЕ

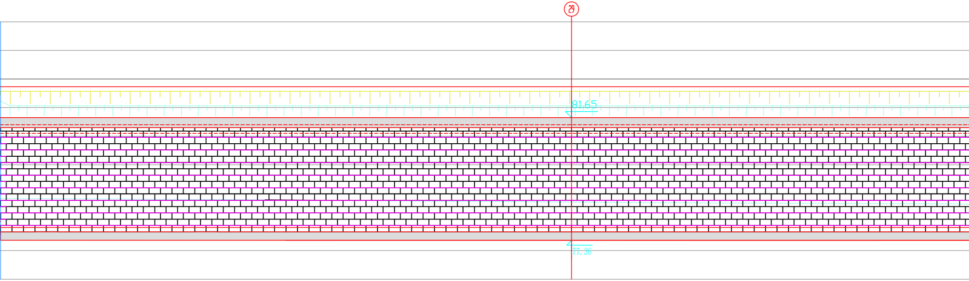
Front view of reinforced soil retaining wall


81.65
геомрежа (geogrid) RW-95 L=5.0m
5%
77.58
1:0.5
1:1.0
1:1.0

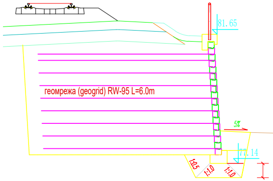

27
28
81.65
81.65
78.02
0.44
77.58

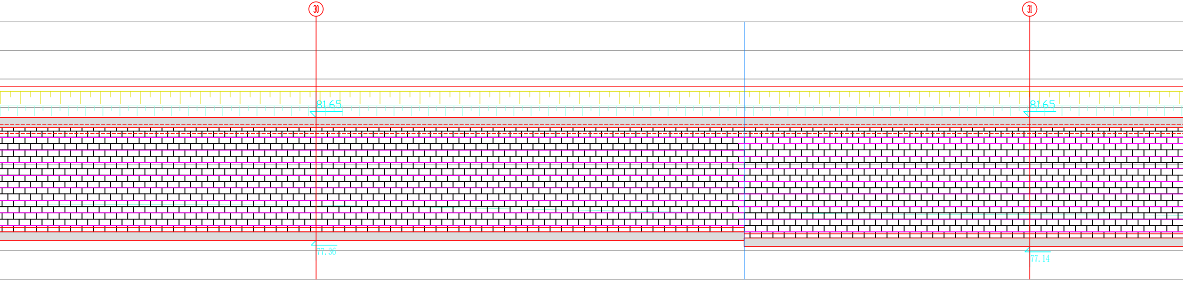
		8×5.0m	
81.65	81.65	81.65	81.65
79.08		78.64	
78.02	78.02	77.58 77.58	77.58
km77+150	km77+165	km77+175	km77+180


81.65
геомрежа (geogrid) RW-95 L=6.0m
5%
77.36
1:0.5
1:1.0
1:1.0
0.50
0.50

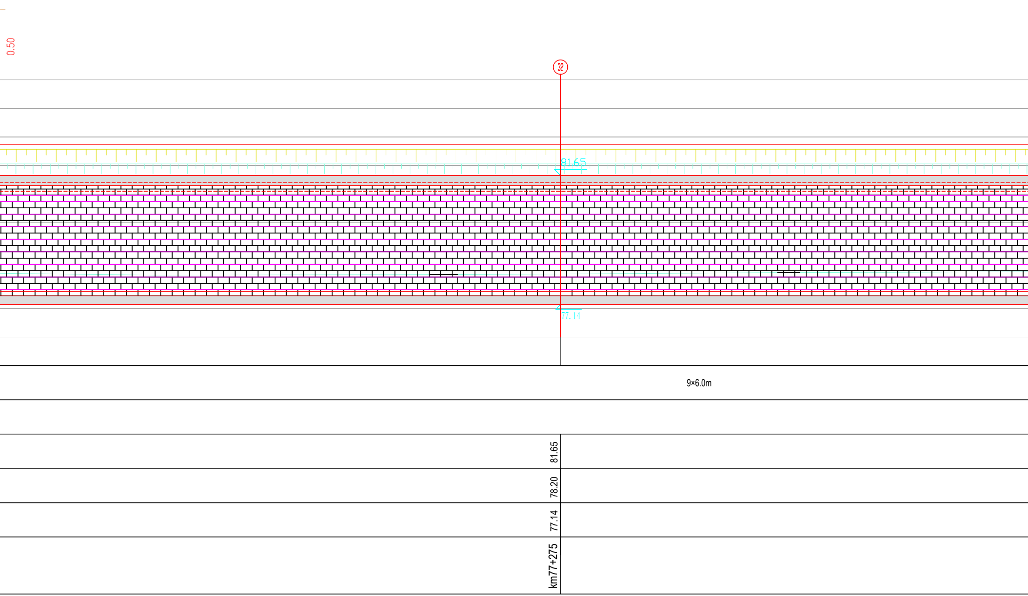

29
81.65
77.36

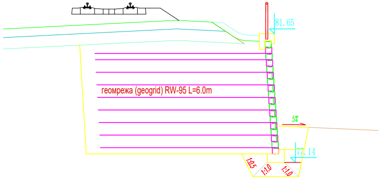
		8×6.0m
	81.65	
	78.42	
77.36	77.36	
	km77+200	

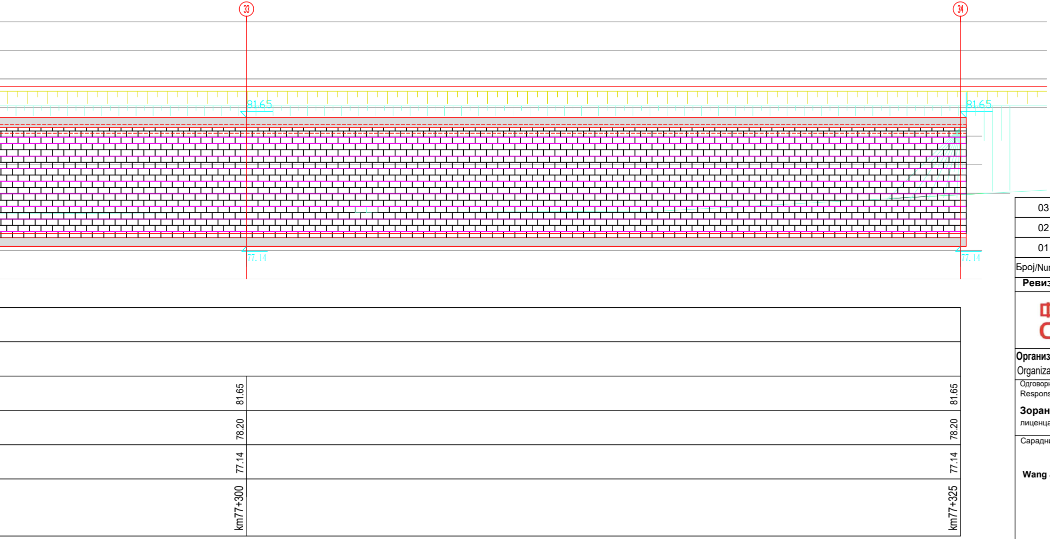

81.65
геомрежа (geogrid) RW-95 L=6.0m
5%
77.14
1:0.5
1:1.0
1:1.0


30
31
81.65
81.65
77.36
77.14

81.65	81.65		81.65
78.42			78.20
77.36	77.36	77.14	77.14
km77+225	km77+240		km77+250


0.50
32
81.65
77.14
9×6.0m
81.65
78.20
77.14
km77+275


81.65
геомрежа (geogrid) RW-95 L=6.0m
5%
77.14
1:0.5
1:1.0
1:1.0


33
34
81.65
81.65
77.14
77.14
81.65
78.20
77.14
km77+300
81.65
78.20
77.14
km77+325

03		
02		
01		
Број/Number	Датум / Date	Опис / Description

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia
Ogranak Beograd

Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master
王 剑

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor
王 剑

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
中国铁路国际有限公司
CHINA RAILWAY International Co., Ltd.
China Railway International Corporation Ltd.
No.10 Fuxing Road,Haidian District,Beijing
P.R China, 100844

CHINA COMMUNICATIONS CONSTRUCTION COMPANY LIMITED
China Communication Construction Company Ltd. (CCCC)
No.85 Deshengmenwai Street,Xicheng District,Beijing
P.R China, 100088

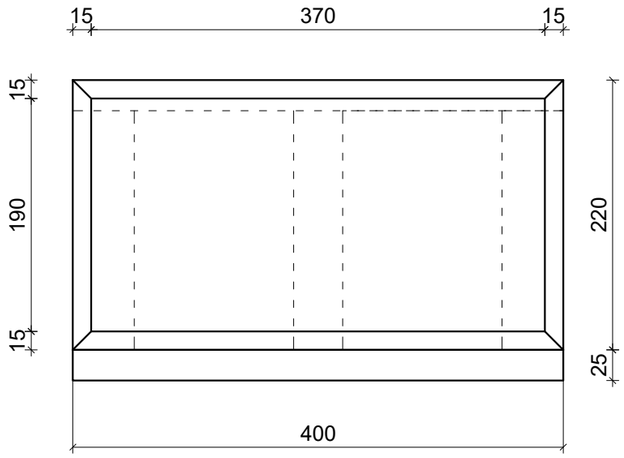
Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

Део пројекта: / Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000～km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000～km77+325)

Цртеж:/ Drawing:
ИЗГЛЕД ЗИДА ОД АРМИРАНЕ ЗЕМЉЕ
Front view of reinforced soil retaining wall

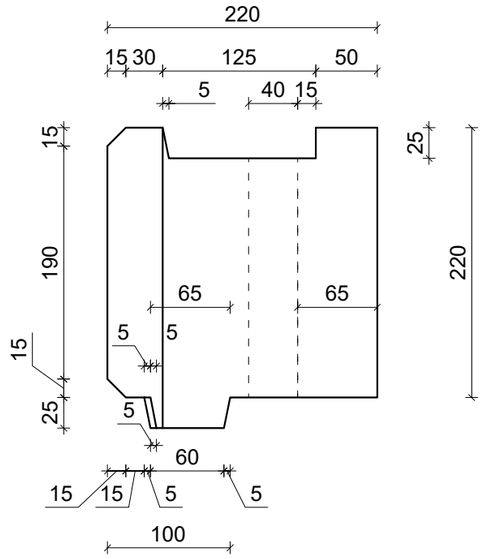
Размера:
Scale:
1:100

Врста тех. док.: Type of tech. docum.:	датум:/date:	Цртеж бр./Drawing No.:
ПГД / DCP	**04.2021.**	**2020-001-ГС-2/4.1-Ц3**



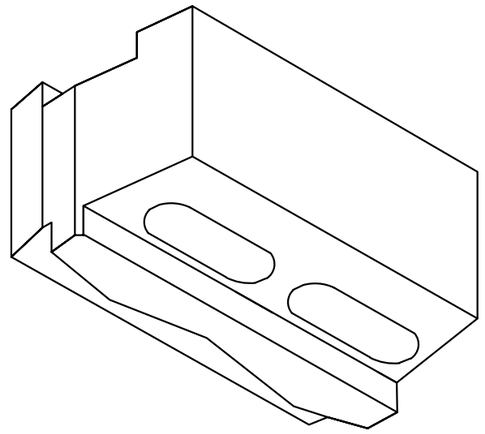
Front View / Поглед спреда

1:5

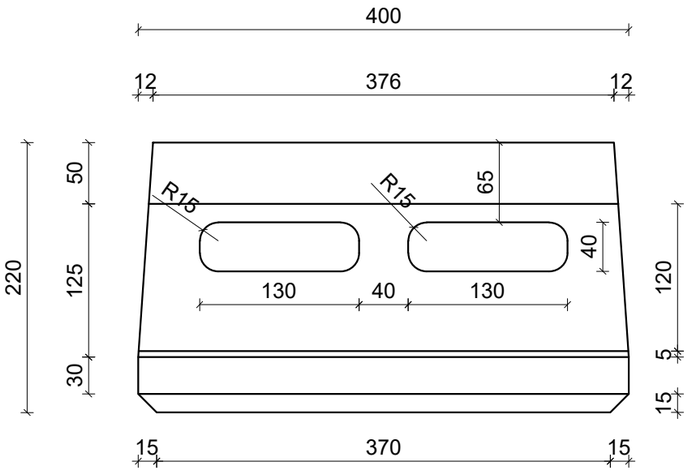


Side View / Поглед са стране

1:5

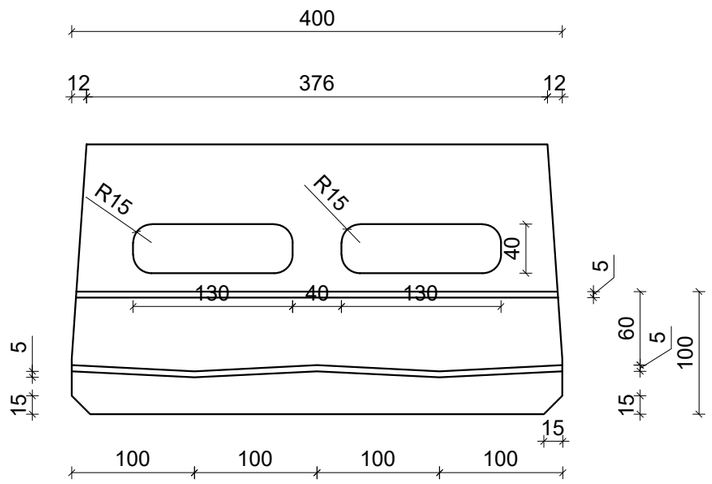


Sketch of Concrete block showing shape of tongue underneath
Скица бетонског блока, приказује облик језичка испод



Top View / Поглед одозго

1:5



Upward View / Поглед одоздо

1:5

Note/ Белешка:

1.Unit: mm./Јединица: mm.

2.Block dimension:400×220×220mm, Precast by concrete C30/37, V-Ⅰ, XF3. / Димензије блока: 400×220×220mm, префабрикован од бетона C30/37, VI, XF3

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
/Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Број/Number	Датум / Date	Опис / Description
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer: China Railway International Corporation Ltd.
No.10 Fuxing Road,Haidian District,Beijing P.R China, 100844

China Communication Construction Company Ltd. (CCCC)
No.85 Deshengmenwai Street,Xicheng District,Beijing P.R China, 100088
Web site: www.ccccltd.cn

Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor 王剑

Сарадници:/ Associates:
Wang Jian. Bachelor & Xia Qidi.Master 王剑 夏启迪

Главни пројектант:/ Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

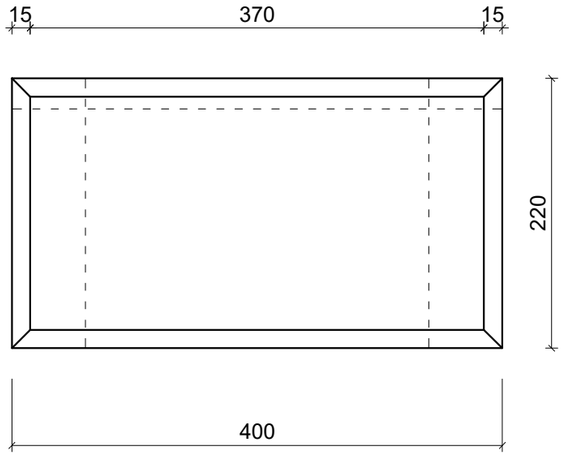
Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Део пројекта: / Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000~km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000~km77+325)

Цртеж:/ Drawing:
Деталь бетонског блока / Details of concrete blocks

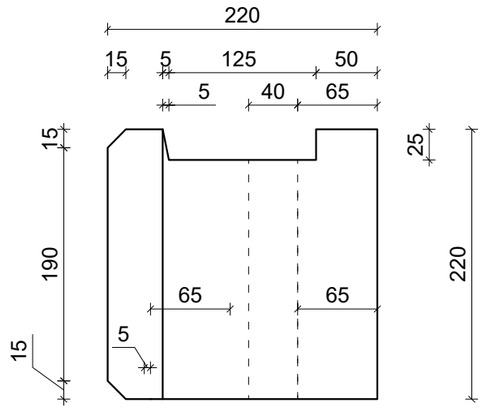
Размера: Scale: 1:5

Врста тех. док.: Type of tech. docum.:	датум:/date:	Цртеж бр./Drawing No.:
ПГД / DCP	**04.2021.**	**2020-001-ГС-2/4.1-Ц4.1**



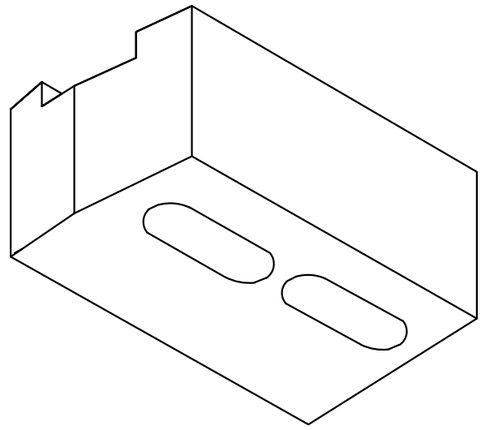
Front View / Поглед спреда

1:5

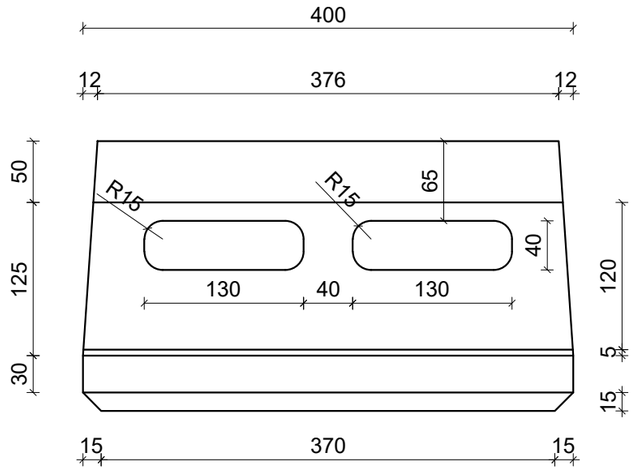


Side View / Поглед са стране

1:5

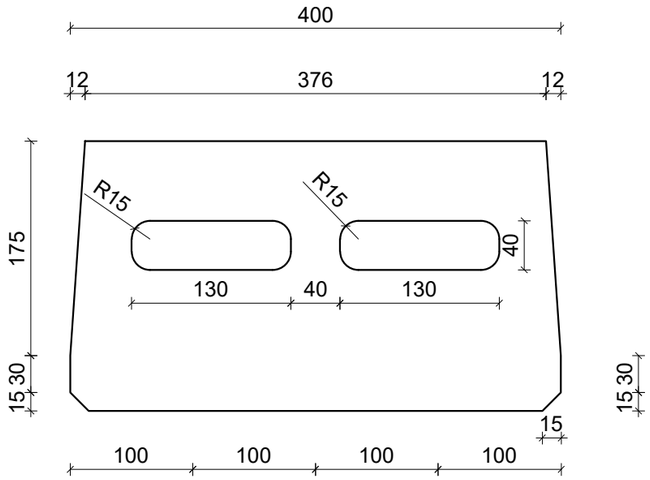


Sketch of concrete block with flat surface for connecting concrete foundation
Скица бетонског блока који повезује равну доњу површину бетонског темеља



Top View / Поглед одозго

1:5



Upward View / Поглед одоздо

1:5

Note/ Белешка:

1.Unit: mm./Јединица: mm.
2.Block dimension:400×220×220mm, Precast by concrete C30/37, V-Ⅰ, XF3. / Димензије блока: 400×220×220mm, префабрикован од бетона C30/37, VI, XF3

02		
01		
Број/Number	Датум / Date	Опис / Description

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia
Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer: China Railway International Corporation Ltd.
No.10 Fuxing Road,Haidian District,Beijing P.R China, 100844

China Communication Construction Company Ltd. (CCCC)
No.85 Deshengmenwai Street,Xicheng District,Beijing P.R China, 100088
Web site: www.ccccltd.cn

Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
/Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Сарадници:/ Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Главни пројектант:/ Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Део пројекта: / Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000~km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000~km77+325)

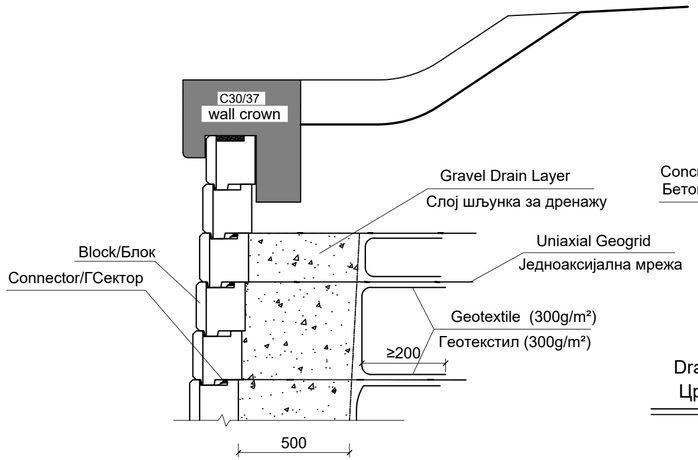
Цртеж:/ Drawing:
Детаљ бетонског блока /
Details of concrete blocks

Размера: Scale: 1:5

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP

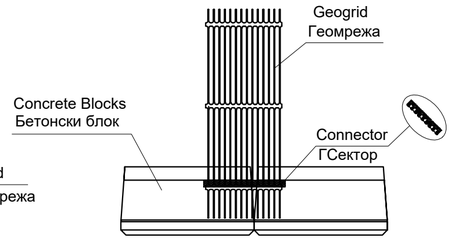
датум:/date: **04.2021.**

Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц4.2**



Structure drawing of the wall crown and module system
Цртеж ГСструкције круне зида и система блокова

1:20



Drawing of Uniaxial Geogrid and Blocks Connection
Цртеж везе једноаксијалне геомреже и блокова

Note: / Белешка:

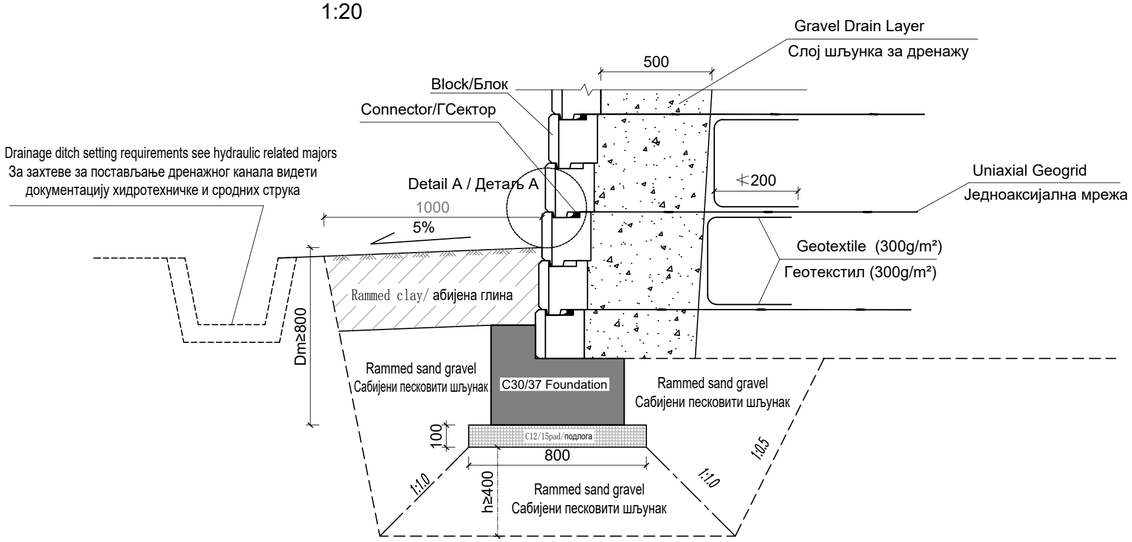
1.Unit: mm. / Јединица: mm.

2.Block dimension:400*220*220mm, Concrete properties shall be of minimum C30/37, V-Ⅰ waterproofing, XF3 frost resistance and 2100kg/m³ gross density. / Димензије блока: 400×220×220mm, својства бетона морају бити минимално C30/37, отпорност на воду V-I, отпорност на смрзавање XF3 и бруто густина 2100kg/m³.

3.Connector is used for joint between blocks and geogrids. / Користи се ГСектор за спајање блокова и геомрежа.

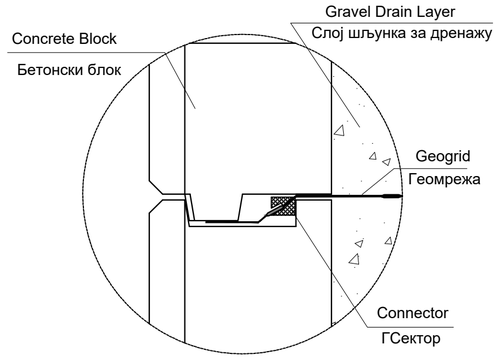
4.All the geosynthetics products which shall be used in the construction of wall must have valid certificate issued by authorized institution of EU, this also refers to reinforced soil wall as a system. The system should be certified by British Board of Agreement, such certification should be provided. / Сви геосинтетички производи који ће се користити у изградњи зида морају имати важећи сертификат издат од овлашћене институције ЕУ, а то се такође односи и на потпорни зид од армиране земље као систем. Систем треба да буде сертификован од стране British Board of Agreement (BBA), потребно је обезбедити такву потврду.

5.The technical requirements for the installation of the drainage system outside the wall can be found in the design drawings of related professions such as hydraulic engineering and roadbed, it is not considered in this design drawing. / Технички захтеви за уградњу дренажног система ван зида могу се наћи у пројектним цртежима повезаних струка као што су хидротехника и земљани труп. Овај пројектни цртеж то не узима у обзир.



Ground treatment sectional drawing, foundation and module system structure drawing
Пресек обраде темељног тла, цртеж темеља и ГСструкције система блокова

1:20



Drawing of detail A
Детаљ А

03		
02		
01		
Број/Number	Датум / Date	Опис / Description

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
中国铁路国际有限公司 CHINA RAILWAY International Co, Ltd.
China Railway International Corporation Ltd. No.10 Fuxing Road,Haidian District,Beijing P.R China, 100844
China Communication Construction Company Ltd. (CCCC) No.85 Deshengmenwai Street,Xicheng District,Beijing P.R China, 100088

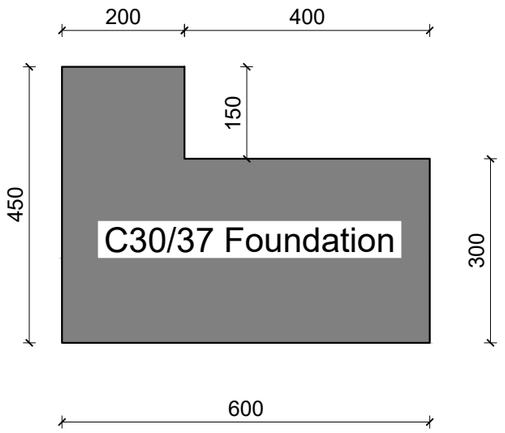
Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

Део пројекта:/ Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000～km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000～km77+325)

Цртеж:/ Drawing:
Систем блокова и темеља, цртеж ГСструкције круне зида / Module system and foundation, wall crown structure drawing

Размера: Scale: 1:20

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP
датум:/date: **04.2021.**
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц5**



Cross Section Drawing of Foundation
Темељ - попречни пресек

1:10

Note / Белешка:

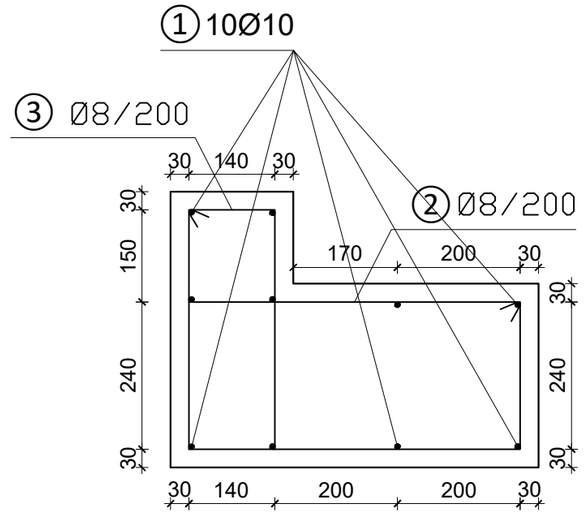
1.Unit mm / Јединица mm

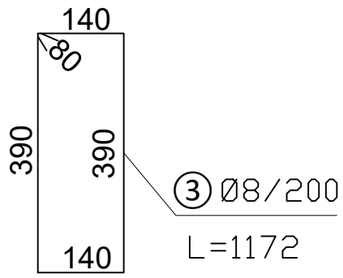
2.Wall crown and Foundation are casted on site. / Круна на зиду и темељ се изливају на локацији.

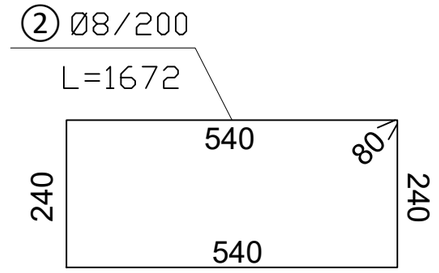
3.Reinforcing steel: B500b / Арматурни челик: B500b

4.Wall crown and Foundation: concrete C30/37, V-Ⅰ, XF3. / Круна зида и темељ: бетон C30/37, V-I, XF3

5.Protective concrete layer a_0=3.0cm / Заштитни слој бетона a_0=3.0cm







SPECIFICATION OF RIBBED FITTINGS _ FOUNDATION（Per linear meter）					
3	8	1.17	6	7.02	
2	8	1.67	6	10.02	
1	10	1.00	10		10.00
Serial number	**Ø**	**length**	**root**	**8**	**10**
∑ lgn / Ø			**m'**	17.04	10.00
∑ weight / Ø			**kg**	6.90	6.34
∑ total			**kg**	***13.24***	

1000

① Ø10 L=1000 (10 root)

Foundation reinforcement drawing
Цртеж арматуре темеља

Број/Number	Датум / Date	Опис / Description
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer: China Railway International Corporation Ltd.
No.10 Fuxing Road,Haidian District,Beijing P.R China, 100844

China Communication Construction Company Ltd. (CCCC)
No.85 Deshengmenwai Street,Xicheng District,Beijing P.R China, 100088
Web site: www.ccccltd.cn

Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
/Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Унутрашња ГСтрола: / Internal control: **Wang Jian. Bachelor**

Сарадници:/ Associates: **Wang Jian. Bachelor & Xia Qidi.Master**

Главни пројектант:/ Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Део пројекта: / Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000~km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000~km77+325)

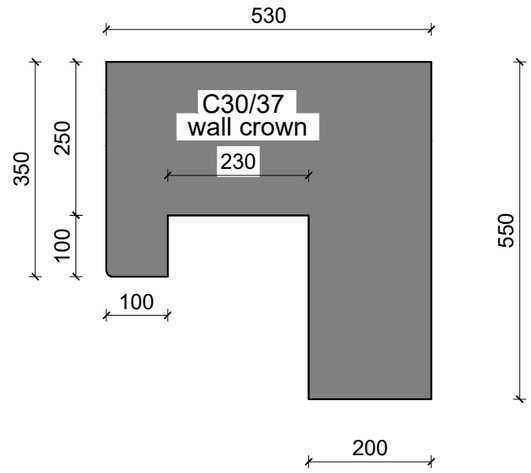
Цртеж:/ Drawing: **Цртеж арматуре темеља / Foundation reinforcement drawing**

Размера: Scale: 1:10

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP

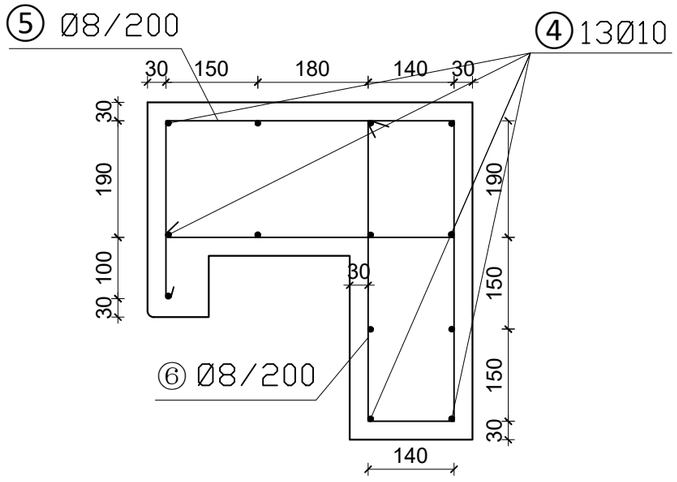
датум:/date: **04.2021.**

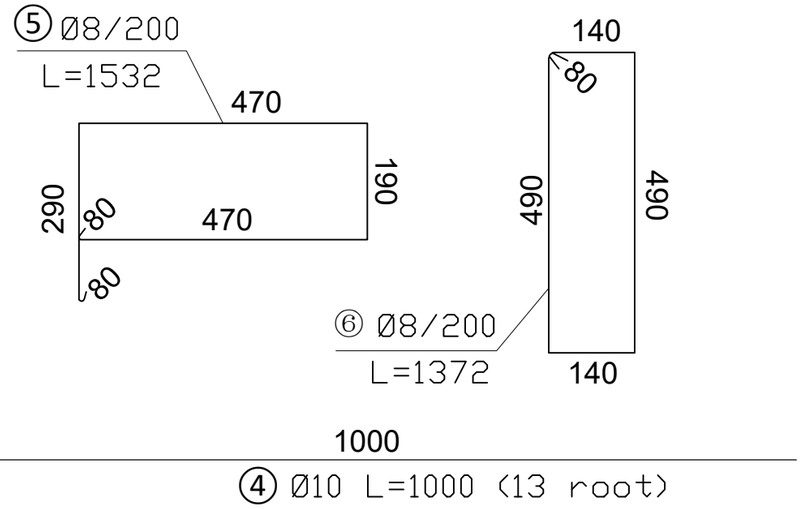
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц6**



Cross Section Drawing of wall crown
Попречни пресек круне зида

1:10





Wall crown reinforcement drawing
Цртеж арматуре круне зида

SPECIFICATION OF RIBBED FITTINGS_Wall crown（Per linear meter）					
6	8	1.37	6	8.22	
5	8	1.53	6	9.18	
4	10	1.00	13		13.00
Serial number	**Ø**	**length(m)**	**root**	**8**	**10**
∑ lgn / Ø			**m'**	17.40	13.00
∑ weight / Ø			**kg**	7.05	8.24
∑ total			**kg**	***15.29***	

Note / Белешка:

1.Unit mm / Јединица mm

2.Wall crown and Foundation are casted on site. / Круна на зиду и темељ се изливају на локацији.

3.Reinforcing steel: B500b / Арматурни челик: B500b

4.Wall crown and Foundation: concrete C30/37, V-Ⅰ, XF3. / Круна зида и темељ: бетон C30/37, V-I, XF3

5.Protective concrete layer a_0=3.0cm / Заштитни слој бетона a_0=3.0cm

Број/Number	Датум / Date	Опис / Description
02		
01		

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer: China Railway International Corporation Ltd.
No.10 Fuxing Road,Haidian District,Beijing P.R China, 100844

China Communication Construction Company Ltd. (CCCC)
No.85 Deshengmenwai Street,Xicheng District,Beijing P.R China, 100088
Web site: www.ccccltd.cn

Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
/Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

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др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Део пројекта: / Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000~km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000~km77+325)

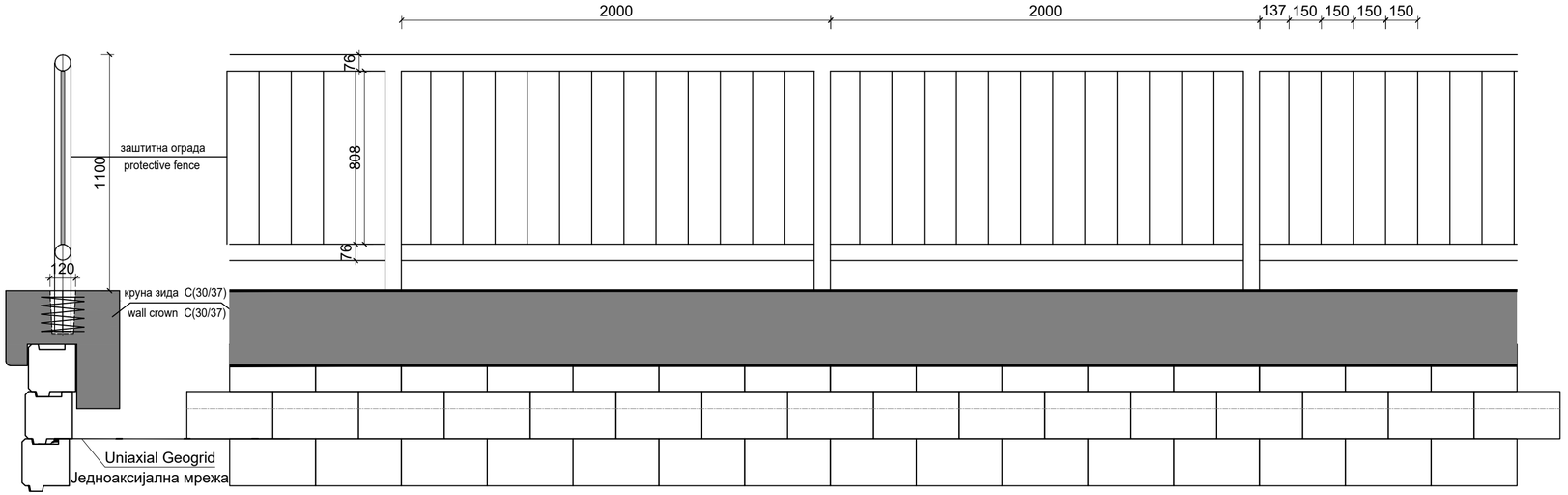
Цртеж:/ Drawing:
Цртеж арматуре круне зида /
Wall crown reinforcement drawing

Размера: Scale: 1:10

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP

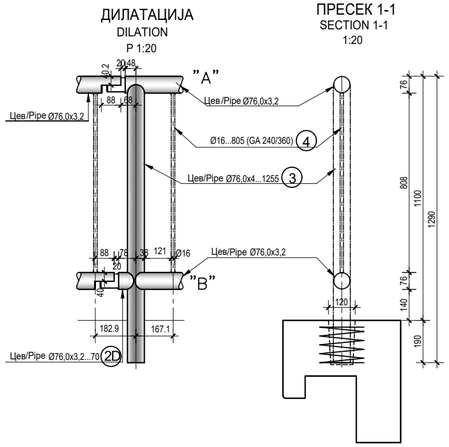
датум:/date: **04.2021.**

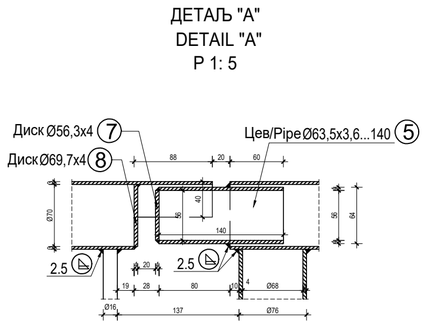
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц7**

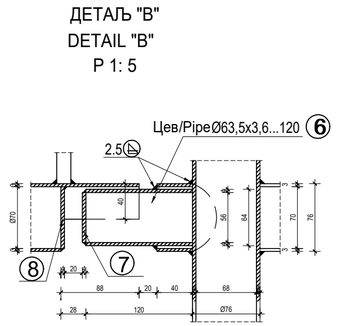


Connection size drawing of wall crown and fence
Цртеж димензија везе круне зида и ограде

1:20







Description/Опис:

Design the starting and ending points of the protective railing:km77+175.75～km77+325.75. length 150 m. / Почетак и крај пројекта заштитне ограде: km77+175,75～km77+325,75. Дужина 150 m.

03		
02		
01		
Број/Number	Датум / Date	Опис / Description

Ревизиони блок: / Revision block:

China Railway Design Corporation Serbia Ogranak Beograd
Косте Рацина 16б; 11000 Београд; Србија

Организациона јединица: ГРАЂЕВИНАРСТВО И САОБРАЋАЈ
Organization unit: DEPARTMENT OF CIVIL AND TRANSPORTATION

Одговорни пројектант:
Responsible designer:
Зоран Луковић, дипл.грађ.инж
лиценца број:/ license No.: 310 3032 03

Сарадници: / Associates:
Wang Jian. Bachelor & Xia Qidi.Master

Унутрашња ГСтрола: / Internal control:
Wang Jian. Bachelor

Главни пројектант: / Chief designer:
др Љиљана Милић Марковић, дипл.грађ.инж.

Руководилац организационе јединице:
Manager of organization unit:
др Љиљана Милић Марковић, дипл.грађ.инж.

Инвеститор пројекта: / Investor:
" ИНФРАСТРУКТУРА ЖЕЛЕЗНИЦЕ СРБИЈЕ " А.Д.
/ " INFRASTRUCTURE RAILWAYS OF SERBIA " JSC
Немањина 6/IV, Београд / Nemanjina Street 6/IV, Belgrade

Наручилац пројекта: / Employer:
中国铁路国际有限公司 CHINA RAILWAY International Co, Ltd.
China Railway International Corporation Ltd. No.10 Fuxing Road,Haidian District,Beijing P.R China, 100844
CHINA COMMUNICATIONS CONSTRUCTION COMPANY LIMITED
China Communication Construction Company Ltd. (CCCC) No.85 Deshengmenwai Street,Xicheng District,Beijing P.R China, 100088

Објекат: /Structure:
ПРУГА БЕОГРАД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
ДЕОНИЦА ПРУГЕ НОВИ САД - СУБОТИЦА - ДРЖАВНА ГРАНИЦА (КЕЛЕБИЈА)
BELGRADE - SUBOTICA - STATE BORDER (KELEBIA) RAILWAY LINE
SECTION : NOVI SAD - SUBOTICA - STATE BORDER (KELEBIA)

Део пројекта:/ Part of Design:
ПРОЈЕКАТ ПОТПОРНИХ КОНСТРУКЦИЈА / DESIGN OF RETAINING WALLS
2/4.1 Зид од армиране земље у станици Нови Сад (km77+000～km77+325)
2/4.1 Reinforced Soil Wall at Novi Sad station (km77+000～km77+325)

Цртеж:/ Drawing:
Детаљ заштитне ограде на врху круне зида /
Detail of the protective fence on top of wall crown

Размера: Scale: 1:20

Врста тех. док.: Type of tech. docum.: **ПГД** / DCP
датум:/date: **04.2021.**
Цртеж бр./Drawing No.: **2020-001-ГС-2/4.1-Ц8**